TRW Automotive

Commercial Steering Systems

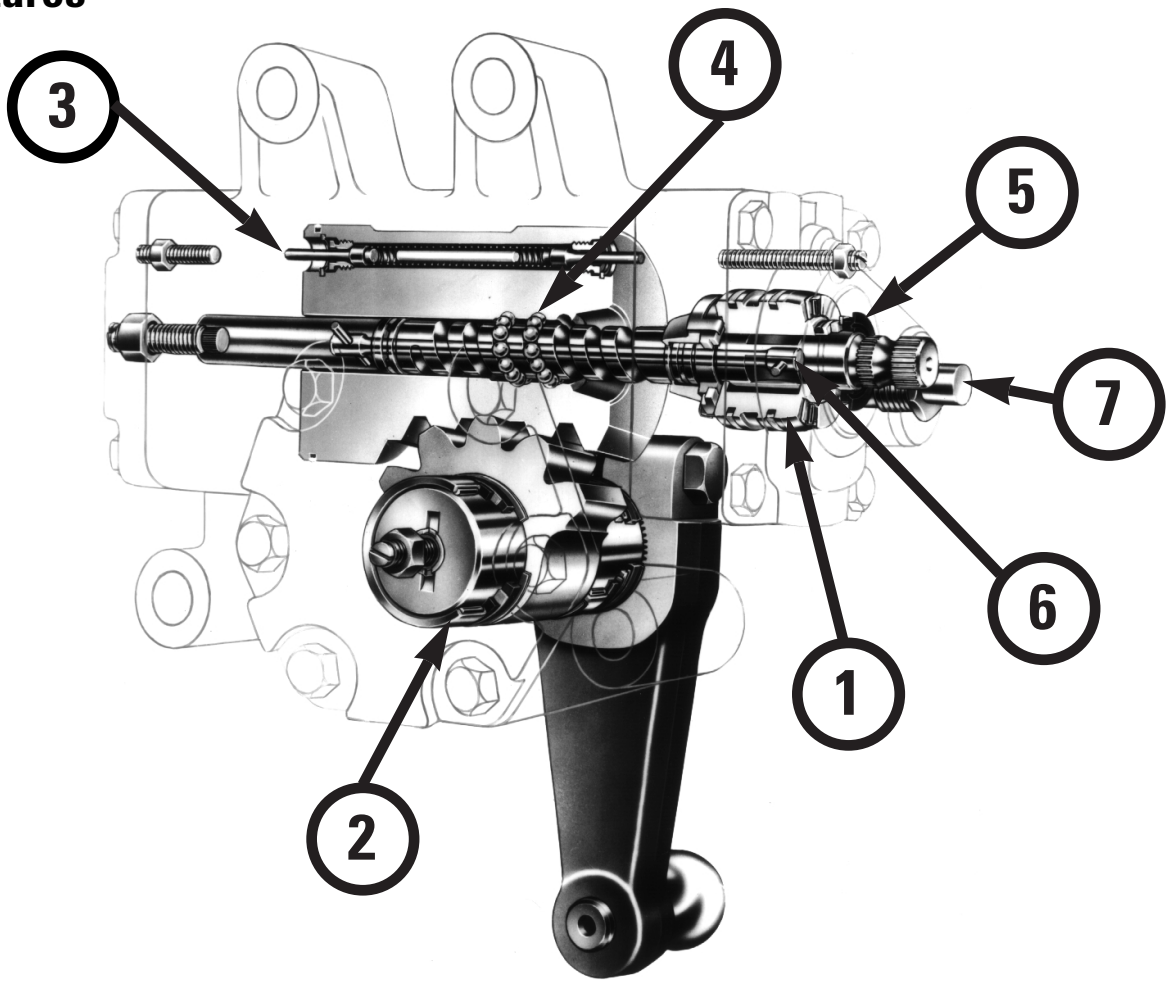
HFB Steering Gear Service Manual

HFB64 SERIES

HFB64 Integral Hydraulic Power Steering Gear

This steering gear was specifically designed for motor trucks; new design features and our design experience with previous models of integral hydraulic power steering gears have been combined into this new product.

Design Features



1. **Rotary Valve** - This device provides responsive steering control
2. ***DU bushing and or Roller Bearings** - Allow the steering gear to operate with high efficiency and reversibility
3. **Unloading Valves** - Furnish power steering pump protection and reduce pressure to unload steering linkage at the ends of steering gear travel (optional)
4. **Recirculating Balls** - Combines high mechanical efficiency with smooth operation
5. **Dirt and Water Seals** - Lip type seals on both input and output shafts
6. **Torsion Bar** - Provides positive valve centering with definitive "feel of the road"
7. **Relief Valves** - Furnish pump protection by limiting maximum pressure (optional)

- Balanced Area Cylinder - Back pressures cannot affect steering stability
- High Temperature Seals - These specially developed seals may be operated intermittently at 300˚ F (148.9˚ C)
- Manual Steering Capability - Provides for steering control in the event of hydraulic failure
- Compactness - Lowest weight to output torque ratio in the industry
- Auxiliary Porting Available - For auxiliary cylinder control
- Seal Protectors - Provide protection from harsh environment

***** DU is a registered trademark of Glacier Metal Co. Ltd.

Definitions

NOTE: **A NOTE gives key information to make a procedure easier or quicker to follow.**

CAUTION: **A CAUTION refers to those procedures that must be followed to avoid damage to a steering component or the gear.**

WARNING: **A WARNING REFERS TO THOSE PROCEDURES THAT MUST BE FOLLOWED FOR THE SAFETY OF THE DRIVER AND THE PERSON INSPECTING OR REPAIRING THE GEAR.**

Disclaimer

This Service Manual has been prepared by TRW Ross Gear Division for reference and use by mechanics who have been trained to repair and service steering components and systems on heavy commercial vehicles. TRW Ross Gear Division has exercised reasonable care and diligence to present accurate, clear and complete information and instructions regarding the techniques and tools required for maintaining, repairing and servicing the complete line of TRW Ross Gear HFB64 Integral Power Steering Gears. However, despite the care and effort taken in preparing this general Service Manual, TRW makes no warranties that (a) the Service Manual or any explanations, illustrations, information, techniques or tools described herein are either accurate, complete or correct as applied to a specific HFB64 steering gear, or (b) any repairs or service of a particular HFB64 steering gear will result in a properly functioning steering gear.

If inspection or testing reveals evidence of abnormal wear or damage to the HFB64 steering gear or if you encounter circumstances not covered in the Manual, STOP - CONSULT THE VEHICLE MANUFACTURER'S SERVICE MANUAL AND WARRANTY. DO NOT TRY TO REPAIR OR SERVICE A HFB64 STEERING GEAR WHICH HAS BEEN DAMAGED OR INCLUDES ANY PART THAT SHOWS EXCESSIVE WEAR UNLESS THE DAMAGED AND WORN PARTS ARE REPLACED WITH ORIGINAL TRW REPLACEMENT AND SERVICE PARTS AND THE UNIT IS RESTORED TO TRW'S SPECIFICATIONS FOR THE HFB64 STEERING GEAR.

It is the responsibility of the mechanic performing the maintenance, repairs or service on a particular HFB64 steering gear to (a) inspect the steering gear for abnormal wear and damage, (b) choose a repair procedure which will not endanger his/her safety, the safety of others, the vehicle, or the safe operation of the vehicle, and (c) fully inspect and test the steering gear and the vehicle steering system to insure that the repair or service of the steering gear has been properly performed and that the steering gear and system will function properly.

Patents

This TRW Ross Gear Division vehicle power steering gear is covered by one or more of the following United States patent numbers: 3,896,702; 3,606,819; 3,741,074; 3,773,081; 3,955,473; 3,935,790; and 3,921,669. Other United States patent applications are pending, and corresponding foreign patents are pending or issued.

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WARNING: ALL STEERING MECHANISMS ARE LIFE AND LIMB ITEMS. AS SUCH, IT IS IMPERATIVE THAT THE INSTRUCTIONS IN THIS BOOKLET ARE FOLLOWED TO THE LETTER. FAILURE TO OBSERVE THE PROCEDURES SET OUT IN THIS PAMPHLET MAY RESULT IN LOSS OF STEERING.

Introduction

Service Manual for Model HFB64

This service manual has one purpose: to guide you in maintaining, troubleshooting and servicing the HFB64 Hydrapower [a] integral power steering gear.

Material in this manual is organized so you can work on the HFB64 and get results without wasting time or being confused. To get these results, you should review the contents of this manual before you begin any work on the HFB64.

The section of this manual on General Design and Operation, treats the major parts of the HFB64 and explains how they function together. The knowledge you acquire from reviewing this section should assist you in solving your steering problem.

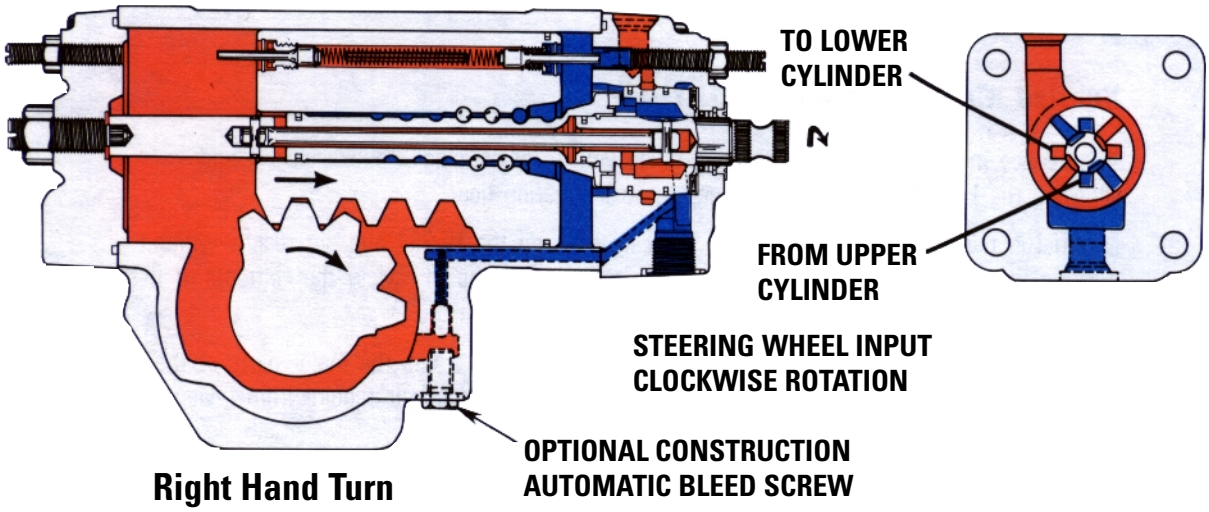
This manual also contains troubleshooting information and checklists. With them, you can diagnose a steering problem without removing the HFB64 from the vehicle. If you must service the HFB64 the checklists will help you to determine where the problem may be.

The three-column format of the Repairs, Adjustments, Disassembly, Inspection and Assembly sections will make it easier for you to service the HFB64. Column 1 gives a brief key for each procedure. Column 2 explains in detail the procedure you should follow. Column 3 illustrates this procedure with photographs. Pay special attention to the notes, cautions and warnings.

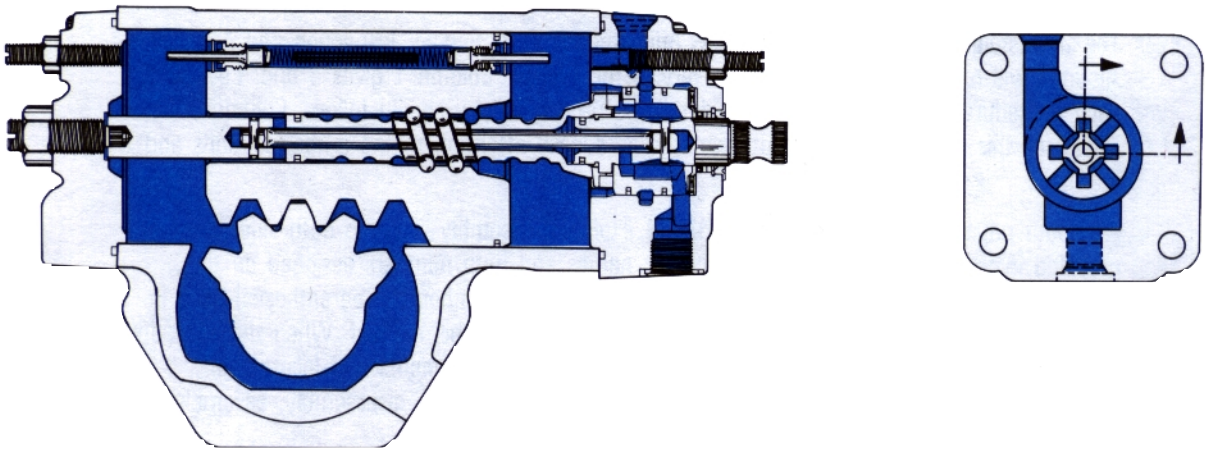
A foldout page with the same typical HFB64 exploded assembly view on both sides is provided in this manual. The component part names and item numbers assigned on this exploded assembly view correspond with names and item numbers (in parentheses) used in the disassembly, assembly and other procedures set forth in this manual. When this exploded assembly view page is folded out, you can easily identify components and locate their relative position on the exploded assembly view as you follow the disassembly, assembly and other procedures.

As you gain experience in servicing the HFB64, you may find that some information in this manual could be clearer and more complete. If so, let us know about it. Don't try to second guess the manual; if you are stuck, contact us. Servicing the HFB64 should be a safe and productive procedure.

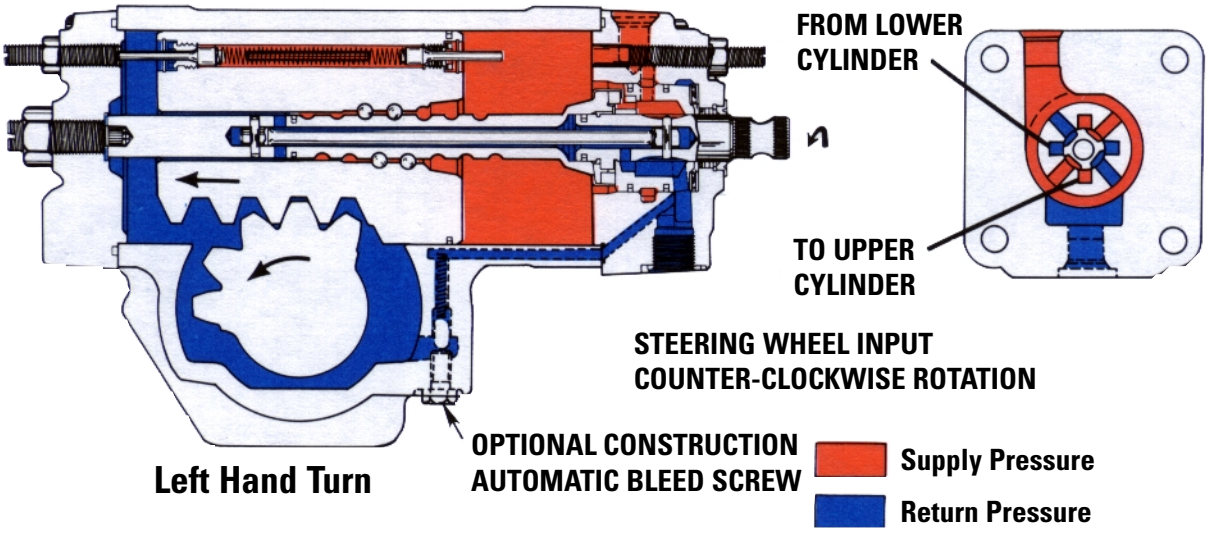
HFB64 Oil Flow Illustration


TO LOWER CYLINDER
FROM UPPER CYLINDER
STEERING WHEEL INPUT CLOCKWISE ROTATION
OPTIONAL CONSTRUCTION AUTOMATIC BLEED SCREW

Right Hand Turn



Neutral - No Steering Action



Left Hand Turn

HFB64: General Design and Operation

Design

Integral Power Steering

The HFB64 power steering gear is the latest design in the Ross family of integral hydraulic power steering gears. Integral hydraulic power steering means that the gear box contains a manual steering mechanism, a hydraulic control valve, and a hydraulic power cylinder, all in a single, compact package.

Rotary Control Valve

The rotary control valve combines simplicity of construction with desirable performance characteristics. The speed at which the driver can turn the steering wheel with power assist is dependent upon the pump flow (measured in gallons per minute-gpm or Liters/Min.) directed to a cylinder cavity.

The pressure (measured in pounds per square inch-psi or bar) required for the gear to steer the vehicle is created by the power steering pump to overcome resistance at the steered wheels. The control valve senses these requirements and directs fluid to the cylinder cavity at the proper flow rate and pressure.

Pressure Means Work, Flow Means Speed

The higher pressure a gear can withstand, the more work it can perform. The HFB64 can steer a vehicle with a front-end weight rating of about 12,000 pounds (5443 Kg) through a turn at low vehicle speed and engine idle. As the driver turns the steering wheel faster or slower, more or less fluid will be required by the gear in one minute. For the HFB64, maximum operating pressure is 2000 psi (137.9 bar), maximum flow rate 6 gpm (22.7 Liters/Min.). NOTE: The recommended minimum flow at 1 1/2 hand wheel turns/second must be no less than 2.9 gpm (11.0 Liters/Min.). If the HFB64 steering gear is controlling an auxiliary cylinder, increased minimum flow is required based on the size of the
auxiliary cylinder and the vehicle's steering geometry.

Operation

What Happens During a Steering Maneuver

When the driver turns the steering wheel, he transmits force from the wheel to the steering gear input shaft. A torsion bar, pinned at its one end to the input shaft and at its other end to the worm shaft, turns with the input shaft and exerts a rotational force on the worm shaft. In response to this rotational force, the worm shaft, acting through the recirculating ball mechanism, tries to move the rack piston axially through the gear housing cylinder bore.

The rack piston's axial movement is resisted by its engagement to the sector shaft, which is connected by linkage to the steered wheels. Because of this resistance, the torsion bar is twisted by the input shaft, thereby actuating the control valve. Pressurized fluid, directed by the control valve, assists in moving the rack piston axially through the cylinder bore. The rack piston then turns the sector shaft to steer the vehicle.

Shock Loads to the Gear

If the steered wheels receive a shock load, the shock forces are transmitted through the sector shaft, to the rack piston, and onto the worm shaft. The internal geometry of the steering gear causes the control valve to send high-pressure fluid to the correct cylinder cavity to resist the shock forces. By absorbing the shock forces hydraulically, the steering gear prevents objectionable kickback at the steering wheel.

Unloading (Poppet) Valves

Some HFB64 gears are equipped with two unloading valves, one at each end of the rack piston. One valve or the other, depending on the direction of turn, will trip as the steered wheels approach the axle stops (which must be set according to manufacturer's specification). The tripped valve reduces pressure in the gear and helps to reduce heat generated by the pump At the same time, the valves also reduce forces on the steering linkage.

Relief Valve

Some HFB64 gears, whether equipped with or without poppets, are also supplied with a relief valve. The relief valve limits maximum supply pressure to protect the power steering pump, but it does not reduce pressure as the steered wheels approach the axle stops.

Bleed Systems

Some HFB64 gears which are mounted with the output shaft above the rack piston bore are equipped with either an automatic bleed system or a manual bleed screw.

The procedure for servicing the manual bleed screw is described under "Filling and Air Bleeding" (page 50) in this manual.

If the unit has an automatic bleed system, illustrated as optional on the oil flow diagram, no servicing is required on the vehicle.

Troubleshooting Information

Preliminary Checks

When a customer comes to you with a problem related to his truck's steering, you can save a lot of time and work if first verify the problem. Make sure you're both talking the same language about the same problem. if he says the truck's hard to steer, find out exactly what he means. Is it hard to steering into a right or left turn? Only when turning the steering wheel while the truck is sitting still? Is there only intermittent power steering? Or is there no power assist at all?

If at all possible, and if it's safe to do so, test drive the truck. If you're not familiar with the rig, let the customer drive it while you sit beside him. Take hold of the wheel while he drives In gel a feel for the problem he's talking about Since most of his driving will be with his truck hauling a load, arrange for a load if one is required to reproduce the steering problem.

Typical Steering System

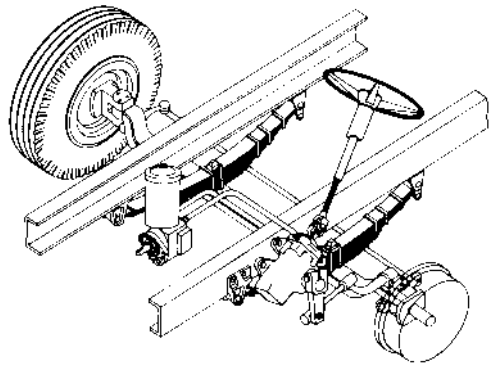


Figure 1

Typical Steering System (with Auxiliary Cylinder)

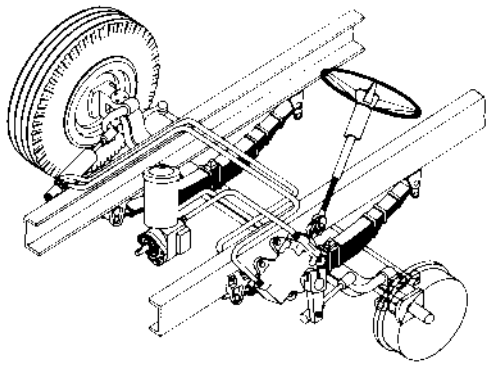


Figure 1A

Once you've determined the problem and its symptoms, don't jump right in to tear the steering gear or pump apart. In most cases, in fact, the gear should be the last component you check. There are many other components in the steering system that could be causing the problem (see FIG. 1 & 1A). These you should check first.

Begin, then by checking the steering wheels: make sure that the tires are at correct pressure and equal all around, that they are properly sized, and that they are not worn or damaged.

Next, have the front-end alignment checked and look for abnormal looseness or tightness in the steering linkage, ball joints, and king pins.

A service replacement hose or fluid line may be misrouted or may be too small in diameter, or it may be restricted in some other way. Reroute any hose that is kinked or bent sharply. Replace any hoses that are not the same as original equipment.

Continue by checking the power steering fluid reservoir to make sure that oil is up to the correct level. Also, check the pump drive belt, if one is used, to see if it is slipping. The belt may be tight, but it may also be glazed, and a slipping belt doesn't always squeal. If you adjust the belt, check the specifications.

These are just some of the checks you should make before you turn to the steering gear or pump. The Troubleshooting Guide on pages 8 through 10 explains what to diagnose for a particular steering problem. Match the trouble symptom against the chart and follow the recommended troubleshooting sequence. Doing so will most likely save you time and may prevent unnecessary repairs and costs.

Hydraulic Tests

If the checks described above all prove satisfactory, it is possible that the cause of the steering problem can be traced to a lack of pressure or insufficient flow. In this case, you may have to do more detailed troubleshooting that involves conducting hydraulic tests.

Preparation for Hydraulic Tests

To conduct the following hydraulic tests, first install a flow meter, pressure gage and load (shut off) valve in the fluid supply line to the steering gear, as indicated by the instructions that come with the flow meter. Steering system analyzers are available with the 3 units integral. Place a thermometer in the reservoir (FIG. 2). You must use a flow meter, and it is recommended that you use a thermometer, if you are to troubleshoot the hydraulic system accurately.

Start the engine and warm the hydraulic system up by partially closing the load valve until the pressure gage reads 1000 psi (69.0 Bar) When the fluid temperature, as indicated on the thermometer, reaches between 125˚ F (51.7˚ C) and 135˚ F (57.2˚ C), open the load valve. The system is warmed up, and you can conduct the tests.

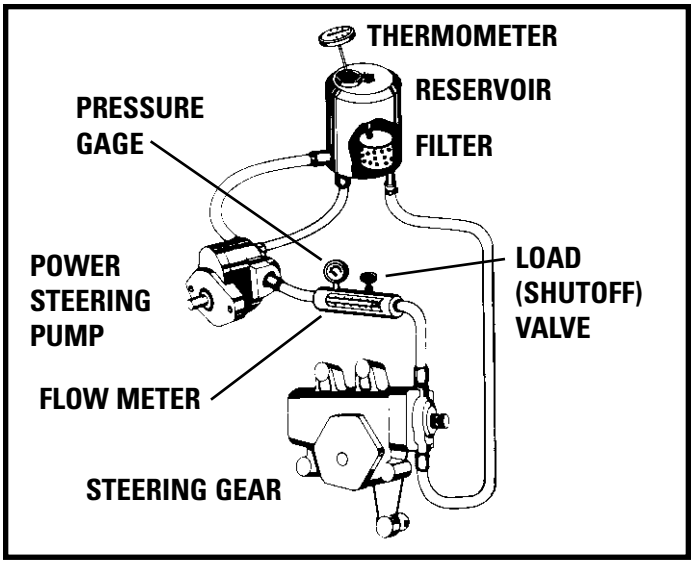


Figure 2

CAUTION: Do not close the load valve completely and leave it closed, or you may damage the pump. At no time allow fluid temperature to exceed 180˚ F (82.2˚ C). Run all the tests at the prescribed temperature range of 125˚ F (51.7˚ C)-135˚ F (57.2˚ C).

Power Steering Pump Pressure Test

With the engine idling, close the load valve and read the pressure gage. If the pressure reads below the minimum specified by the pump manufacturer, repair or replace the pump.

CAUTION: Do not keep the load valve closed for longer than 5 seconds to avoid damaging the pump. Closing the load valve causes the pump to operate at relief pressure and the fluid temperature to increase rapidly. Allow fluid to cool between 125˚ F (51.7˚ C) and 135˚ F (57.2˚ C) before you resume with the other tests.

Power Steering Pump Flow Test

WARNING: MAXIMUM FLOW RATE FOR THE HFB64 STEERING GEAR IS 6 GPM (22.7 LITER/MIN). FLOW RATE SHOULD NOT EXCEED 6 GPM (22.7 LITER/MIN). EXCESSIVE FLOW CAN CAUSE DAMAGE TO INTERNAL PARTS OF THE STEERING GEAR, WHICH COULD RESULT IN A LOSS OF POWER STEERING.

NOTE: If flow specifications and methods of checking flow rate are provided by the vehicle manufacturer, you should follow those instructions rather than the procedure described below.

With the engine idling and the fluid temperature between 125˚ F (51.7˚ C) and 135˚ F (57.2˚ C), check the pump manufacturer's specifications for flow rate. Compare these specifications with the flow rate on the flow meter.

Now, fully close the load valve until the pressure gage registers the pressure at which the pump is relieving. When pump relief is reached, flow rate must be zero. **IMMEDIATELY OPEN THE LOAD VALVE.** The flow rate must instantly return to the original reading. If this rate does not return immediately, the pump is malfunctioning, which can result in intermittent power assist.

Now, set the engine at governed rpm, and fully close the load valve again until pump relief is reached. At pump relief, the flow rate must be zero. **IMMEDIATELY OPEN THE LOAD VALVE.** The flow rate must instantly return to the original reading If this rate does not return immediately, the pump is malfunctioning, which can result in intermittent power assist.

NOTE: Conduct the pump flow test once at idle rpm and three times at governed rpm.

CAUTION: Do not allow the fluid temperature to exceed 180˚ F (82.2˚ C). Run each phase of this test between 125˚ F (51.7˚ C) and 135˚ F (57.2˚ C).

Steering Gear Internal Leakage Test

To test the steering gear for internal leakage, you must first prevent operation of the gear's internal unloading (poppet) valves or relief valve (or both, in some gears) This will allow full pump relief pressure to develop. To prevent operation of the poppets, place an unhardened steel spacer block, about 1 inch thick and long enough to keep your fingers clear, between the axle and stop at one wheel (see FIG. 3). To prevent operation of the relief valve, remove the relief valve by following disassembly step 18. Install the relief valve plug, special tool J29059, in its place.

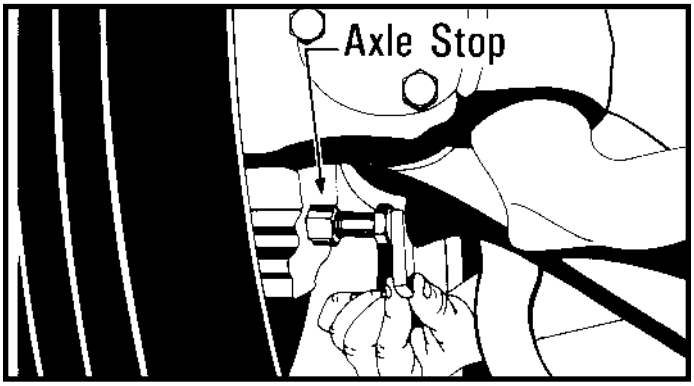


Figure 3

NOTE: Be sure you reinstall the relief valve, with new seals and O rings, back onto the gear. Follow assembly step 29.

With the fluid temperature between 125¡F (51.7¡C) and 135¡F (57.2¡C), turn the steering wheel until the axle stops bottom on the spacer block (FIG. 3).

CAUTION: When running this test, do not hold the steering wheel in the full turn position for longer than 5 to 10 seconds at a time to avoid damaging the pump.

WARNING: KEEP YOUR FINGERS CLEAR OF THE AXLE STOPS AND SPACER BLOCK DURING THIS TEST. MAKE SURE THAT THE SPACER BLOCK CONTACTS THE AXLE STOP SQUARELY. CONTACT THAT IS NOT SQUARE COULD BREAK THE AXLE STOPS OR DANGEROUSLY THROW OR EJECT THE SPACER BLOCK.

Apply 20 lbs. (9.1 KG) to the rim of the steering wheel during this test to be sure that the steering gear control valve is fully closed, The pressure gage should now read pump relief pressure, as noted during the pump pressure test, You can now read steering gear internal leakage on the flow meter.

Acceptable internal leakage can range from 0 to 1.5 gpm (5.7 Liters/Min.).

Repeat this test for the opposite direction of turn.

If internal leakage is greater than 1.0 gpm (3.8 Liters/Min) and there is no auxiliary hydraulic cylinder in the system, repair the gear. If the internal leakage is greater than 1.5 gpm (5.7 Liters/ Min) and there is an auxiliary hydraulic cylinder in the system, controlled by the HFB64 gear, isolate the auxiliary cylinder from the system by disconnecting the auxiliary cylinder hydraulic lines at the HFB64 unit's auxiliary ports. Plug those ports with suitable pressure plugs or caps. Connect the disconnected lines together if a rotary auxiliary cylinder is in the system. Plug the disconnected lines if a linear auxiliary cylinder is in the system and disconnect the linear cylinder from the steering linkage, making sure it will clear the steered axle. Repeat the internal leakage test. If the internal leakage is less than 1.0 gpm (3.8 Liters/Min), repair the auxiliary cylinder. If the internal leakage is greater than 1.0 gpm (3.8 Liters/Min.), repair the HFB64 gear. See internal leakage diagram (FIG. 4).

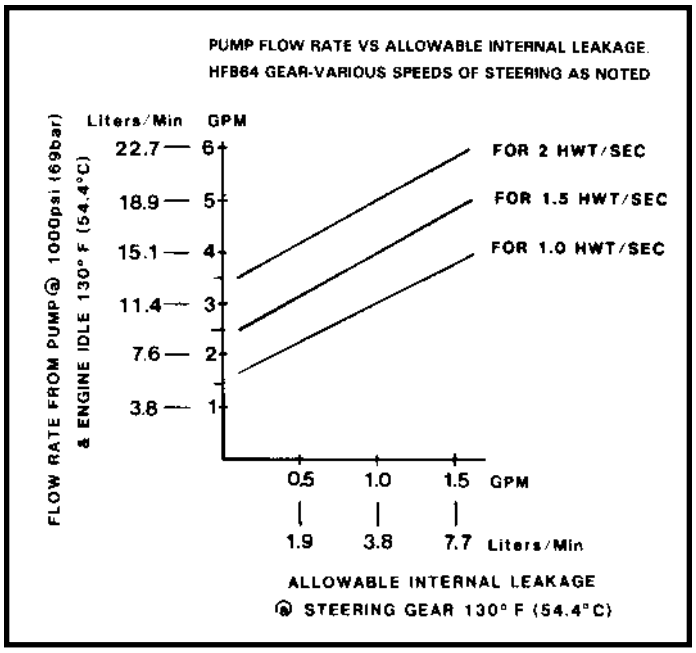


Figure 4

NOTE: When hydraulic tests are completed and fluid lines are reconnected, check fluid level and air bleed the system. Reference page 50.

NOTE: If all seals as included in the complete seal kit have been correctly replaced, and the HFB64 steering gear cannot pass the internal leakage test, or if intermittent lose of power steering occurs, a service worm shaft/input shaft, valve sleeve assembly is required.

Troubleshooting Guide

I. Normal Noises

- You or the driver may hear a hissing noise from the control valve when it is actuated during a steering maneuver.
- You or the driver may hear a noise as fluid bypasses through the poppets at full turn.
- You or the driver may hear a noise from the system relief valve when it is required to actuate.
- You or the driver may hear pump growl from some types of power steering pumps.

II. Abnormal Noises

- If the power steering pump is belt driven, . squealing noise may indicate that the belts should be tightened or replaced.
- A clicking noise heard during a turn, or when changing directions, may indicate that some component is loose and shifting under load.
- A change in the normal noise of the pump may indicate that air has been induced into the system or that fluid level is low.

III. Possible Steering Problems and Causes

Road Wander

- Tire pressure incorrect or unequal left to right.
- Components in steering linkage loose or worn (Steering wheel to Road Wheel.
- Wheel bearings improperly adjusted or worn.
- Front end alignment out of specification.
- Dry fifth wheel or poor finish on fifth wheel or trailer plate.
- Steering gear mounting bolts loose on frame.
- Looseness in rear axle assemblies or trailer bogies.

No Recovery

- Tire pressure low
- Front end components binding
- Front end alignment incorrect
- Tight front axle king pins
- Dry fifth wheel or poor finish on fifth wheel or trailer plate
- Steering column binding
- Pump flow insufficient
- Steering gear improperly adjusted
- Steering gear control valve sleeve sticking

Shimmy

- Badly worn or unevenly worn tires
- Improperly mounted tire or wheel
- Wheel bearings improperly adjusted or worn
- Components in steering linkage loose or worn
- Wheels or brake drums out of balance
- Front end alignment incorrect
- Air in the hydraulic system

External Oil Leakage

- Finding the location of leak may be difficult, since oil may run away from leak source, the fittings, hoses, pump, or gear to a low point on the gear or chassis.
- A leak from the vent plug at the side cover indicates failure of the sector shaft oil seal inside the side cover.

Oversteering or Darting

- Dry fifth wheel or poor finish on fifth wheel or trailer plate
- Front end components binding or loose
- Steering column binding

- Steering gear improperly adjusted
- Steering gear control valve sleeve sticking
- Rear axle mounts (rear steer)

High Steering Effort in One Direction

- Unequal tire pressure
- Vehicle overloaded
- Inadequate hydraulic system pressure
- Excessive internal leakage in one direction of turn only (verify with internal leakage test)

High Steering Effort in Both Directions

- Low tire pressure
- Vehicle overloaded
- Low hydraulic fluid level
- Low pressure or flow from pump
- Components of steering system binding
- Restriction in return line, or line too small in diameter
- Excessive internal leakage (verify with internal leakage test)
- Oversize tires (check manufacturer's specifications)

Lost Motion (Lash) at the Steering Wheel

- Steering wheel loose on the shaft
- Loose connection between the steering gear, intermediate column, and steering column
- Steering gear loose on frame
- Pitman arm loose on output shaft
- Components in steering linkage loose or worn
- Steering gear improperly adjusted

Excessive Heat [(150˚ F (65.6˚ C) Over Ambient] Not to Exceed 250˚ F (121˚ C) Continuously

- Excessive pump flow
- Vehicle overloaded
- Undersized replacement hose or line
- Restricted hose or line that is kinked or severely bent or internally blocked
- Restricted recentering of gear valve caused by column bind or side load on the input shaft
- Poppet not adjusted properly (only for gears equipped with poppets)
- Prolonged stationary vehicle operation

WARNING: IF THE HYDRAULIC SYSTEM FLUID BECOMES OVERHEATED, IT CAN CAUSE THE SEALS IN THE STEERING GEAR AND PUMP TO SHRINK, HARDEN, OR CRACK AND LOSE THEIR SEALING ABILITY.

Repairs and Adjustments on Vehicle

When you have conducted the checks and tests described in the troubleshooting sections, you may find it necessary to repair or adjust the steering gear. Since removing the gear from the vehicle is usually difficult and time-consuming, you will probably find it easier to perform the following repairs and adjustments with the gear on the vehicle. The photographs in this section show a gear mounted on a mock-up frame for clearer illustration.

1 The Sector Shaft And Trunnion Cover

remove pitman arm

1.1 If a leak is detected in the trunnion cover area, on many HFB64 installations, you can remove the trunnion cover to gain access to the sector shaft seal package while the steering gear is on the vehicle. First remove the pitman arm nut and bolt and then the pitman arm from the sector shaft (50). SEE FIGURES 5 & 6. Check the radial position of the pitman arm to the sector shaft prior to removal of pitman arm. Add timing marks to the arm and shaft if necessary to insure correct alignment at reassembly.

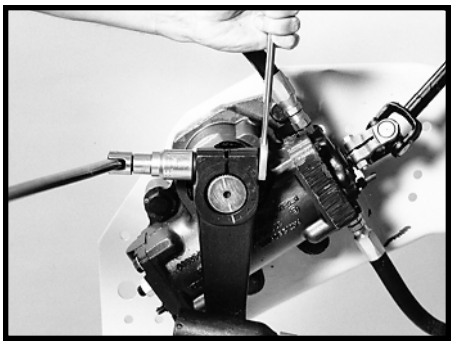


Figure 5

NOTE

NOTE: A chisel will help you loosen the pitman arm. Use only a puller if you cannot remove the pitman arm with your hands.

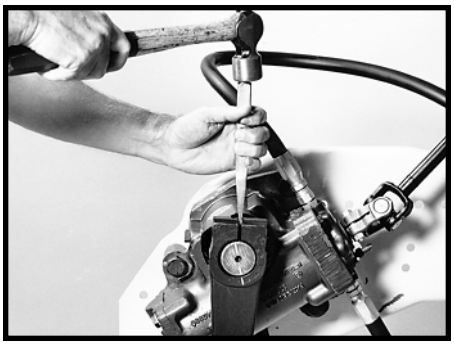


Figure 6

WARNING

WARNING: WHEN USING A CHISEL TO SPREAD THE PITMAN ARM BOSS IN ORDER TO LOOSEN THE PITMAN ARM FOR REMOVAL FROM THE SHAFT, MAINTAIN A FIRM GRIP ON THE CHISEL AT ALL TIMES. FAILURE TO DO THIS MAY RESULT IN THE CHISEL FLYING LOOSE WHICH COULD CAUSE AN INJURY. NEVER LEAVE THE CHISEL WEDGED IN THE PITMAN ARM BOSS. IF YOU CANNOT REMOVE THE PITMAN ARM FROM THE SHAFT WITH A CHISEL AND YOUR HANDS, REMOVE THE CHISEL FROM THE PITMAN ARM AND USE A PULLER ONLY TO REMOVE THE PITMAN ARM.

remove protector boot, fitting and dirt and water seal

1.2 Remove protector boot (63), grease fitting (64), if included, and dirt and water seal (27). SEE FIGURE 7. Discard protector boot and dirt and water seal.

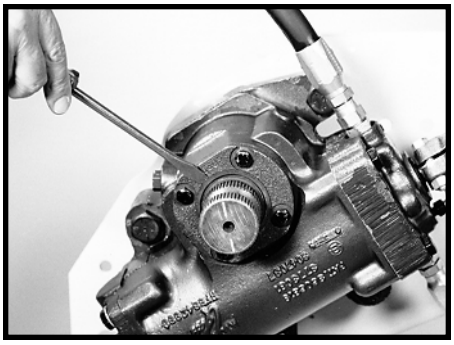


Figure 7

clean sector shaft

1.3 Clean the sector shaft (50) with a fine grade of emery paper. Be sure to remove any paint. SEE FIGURE 8.

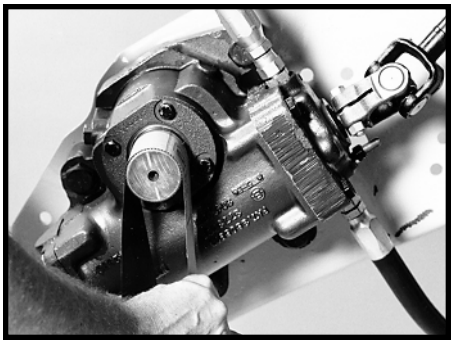


Figure 8

remove trunnion cover and seal package

1.4 Next, remove the four trunnion cover bolts (28), and trunnion cover (26). SEE FIGURE 9. A 1/2 inch socket required. Be prepared for fluid loss. Then remove and discard the sector shaft seal package consisting of the two-piece sector shaft seal (23), the *Teflon backup washer (24), and the trunnion cover seal ring (25). SEE FIGURE 10.

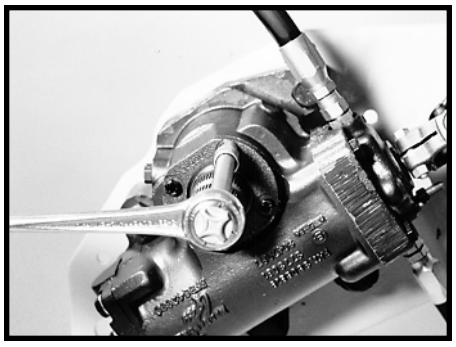


Figure 9

clean and inspect trunnion cover

1.5 Clean the trunnion cover (26) with petroleum based solvent and inspect the seal cavity and sealing face for nicks or corrosion. Replace the trunnion cover with a new one if these conditions exist.

WARNING

WARNING: SINCE THEY ARE FLAMMABLE, BE EXTREMELY CAREFUL WHEN USING ANY SOLVENT. EVEN A SMALL EXPLOSION OR FIRE COULD CAUSE INJURY OR DEATH.

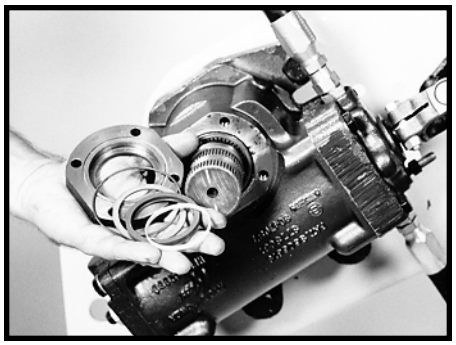


Figure 10

install new washer

1.6 Place the trunnion cover (26) on a bench to install the new seal package. Start with the Teflon backup washer (24).

install new seal

1.7 Install the two-piece sector shaft seal (23), so that the words "oil side" are visible after seal is in place. SEE FIGURE 11.

WARNING

WARNING: THE WORDS "OIL SIDE" MUST BE VISIBLE ON THE SEAL AFTER IT IS IN PLACE. THE SEAL WILL NOT FUNCTION IF THE SEAL IS REVERSED AND A LOSS OF POWER STEERING ASSIST MAY OCCUR.

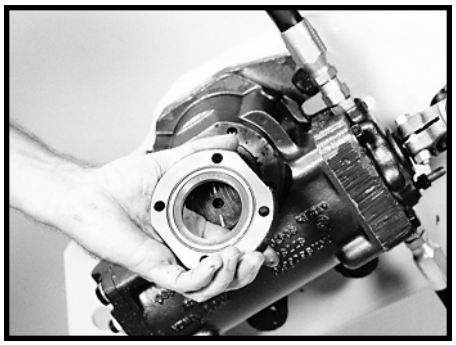


Figure 11

install new seal ring

1.8 Grease the new trunnion cover seal ring (25) and install it into the cover groove.

tape sector shaft

1.9 Cover the serrations of the sector shaft (50) with tape to avoid damaging the seals during installation. SEE FIGURE 12.

NOTE

NOTE: Use only one layer of tape.

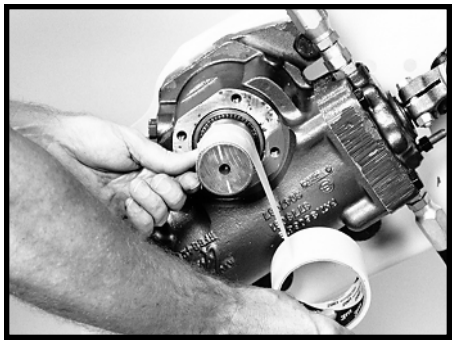


Figure 12

install trunnion cover & bolts

1.10 Install the trunnion cover (26) and four trunnion bolts (28). Torque bolts to 15-22 ft. lbs. (20-30 N m) if dry or 11-16 ft. lbs. (15-22 N m) if lubricated. One-half inch socket required. SEE FIGURES 13, 14.

*Teflon is a registered trademark of DuPont Corporation

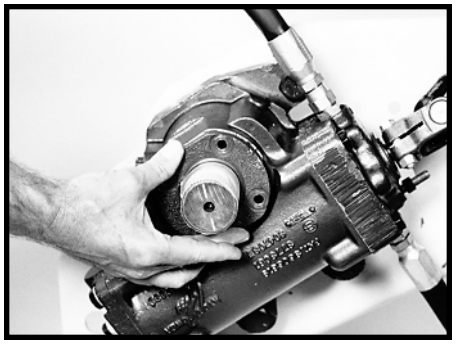


Figure 13

install new dirt and water seal

1.11 Pack clean high temperature industrial grease per Ross specification 045231, *Mobil Temp. 1 or 2 or equivalent around seal area of sector shaft (50). Install a new dirt and water seal (27) using a suitable blunt end drift. SEE FIGURE 15.

assemble protector boot & fitting

1.12 Apply a generous amount of the same grease to protector boot (63) in the area inside of the smaller diameter ring. Assemble protector boot onto sector shaft (50) and trunnion cover (26), locating the grease fitting hole toward the input shaft end of gear assembly. Insert grease fitting (64) into protector boot, if included. Remove tape from sector shaft serrations. SEE FIGURE 16.

NOTE

NOTE: The current protector boot does not have a grease fitting (64).

install pitman arm

1.13 Reconnect the pitman arm, making sure the timing mark on the pitman arm aligns with the timing mark on the sector shaft. SEE FIGURE 17.

WARNING

WARNING: WHEN USING A CHISEL TO SPREAD THE PITMAN ARM BOSS FOR ASSEMBLY ONTO THE SECTOR SHAFT (50), MAINTAIN A FIRM GRIP ON THE CHISEL AT ALL TIMES. FAILURE TO DO THIS MAY RESULT IN THE CHISEL FLYING LOOSE WHICH COULD CAUSE AN INJURY. NEVER LEAVE THE CHISEL WEDGED IN THE PITMAN ARM BOSS.

install and torque pitman arm bolt

1.14 Insert the pitman arm clamp bolt and nut assembly, using a 3/4-16 grade 8 bolt. SEE FIGURE 18. If the bolt is lubricated or plated, torque it to 300-320 ft. lbs. (407-434 N m). If dry and unplated, torque to 380-420 ft. lbs. (515-569 N m).

CAUTION

CAUTION: Be sure there is no spreading wedge left in the pitman arm boss before torquing pitman arm clamp bolt.

fill and bleed system

1.15 Before operating the steering gear, fill the system with the recommended fluid and bleed air from the system by following the Filling and Air Bleeding instructions on page 50.

*Mobil Temp is a registered trademark of Mobil Oil Co.

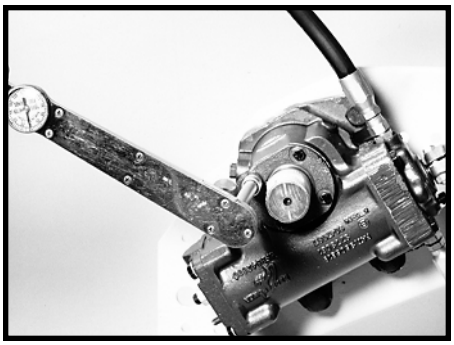


Figure 14

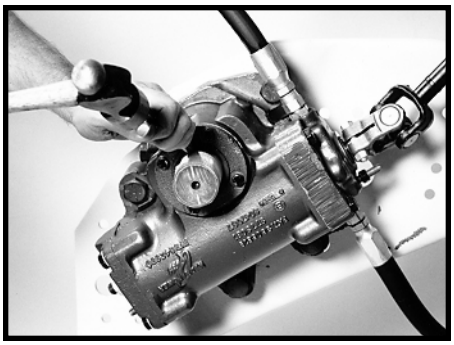


Figure 15

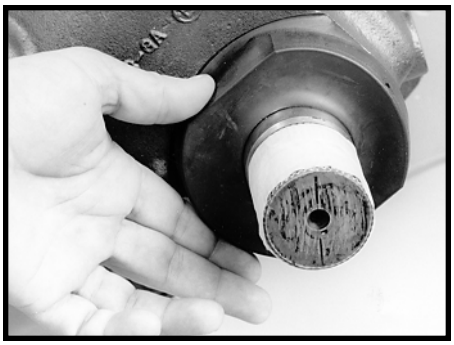


Figure 16

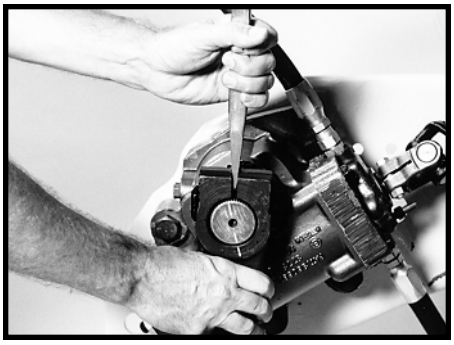


Figure 17

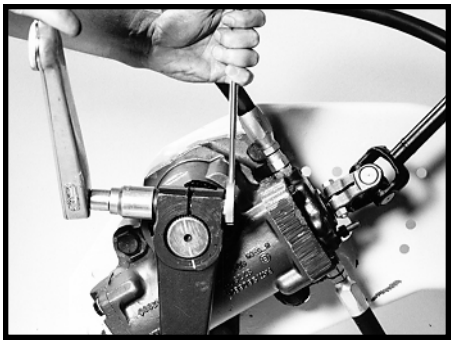


Figure 18

2 The Worm Shaft/Input Shaft Seal

remove input coupling; clean input shaft

2.1 If there is a leak in the shaft seal, you can usually replace the input shaft seal assembly (7 and 8) with the gear on the vehicle. Start by removing the input coupling per the vehicle manufacturers instructions. SEE FIGURE 19. Remove seal protector (62) and clean the area around the input shaft with a fine grade of emery paper. SEE FIGURE 20.

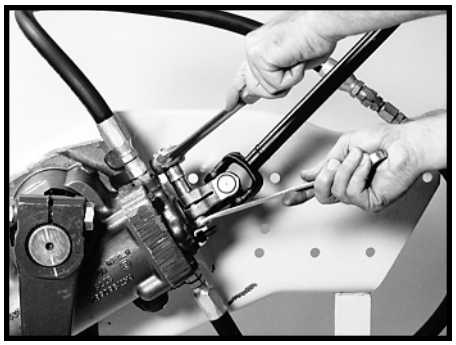


Figure 19

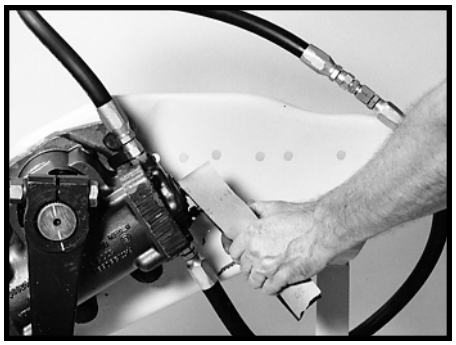


Figure 20

WARNING

WARNING: DO NOT DRIVE OR PRY COUPLING FROM SHAFT. INTERNAL DAMAGE TO THE STEERING GEAR CAN RESULT. IF COUPLING IS TIGHT, INSERT SCREWDRIVER INTO SLOT TO RELEASE.

remove and plug the return line

2.2 Remove and plug the return line. SEE FIGURE 21.

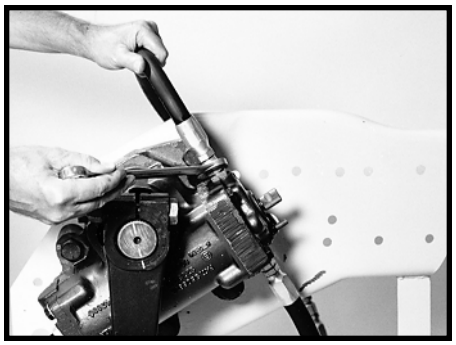


Figure 21

remove seal

2.3 Remove and discard the dirt and water seal (4). SEE FIGURE 22.

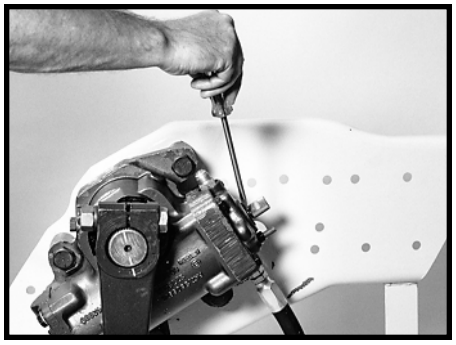


Figure 22

remove retaining ring

2.4 Remove the seal retaining ring (5) from the valve housing (9). SEE FIGURE 23.

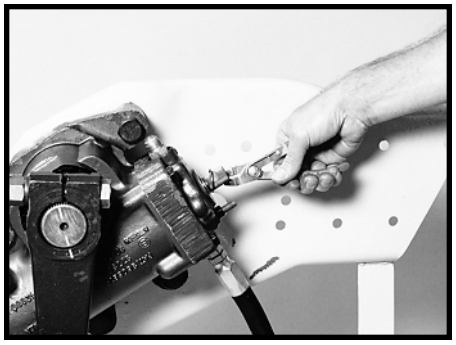


Figure 23

apply air pressure to port

2.5 Hold a shop rag over the worm shaft/input shaft (17) and apply shop air pressure to the valve housing return port. SEE FIGURE 24.

WARNING

WARNING: WEAR EYE PROTECTION AND BE SURE TO COMPLY WITH OSHA OR OTHER MAXIMUM AIR PRESSURE REQUIREMENTS.

Figure 24

remove seal and washer

2.6 The air pressure will force the two-piece input shaft seal (7 and 8) and the steel backup washer (6) to pop out of the gear, and some fluid will leak from the gear. Discard the two-piece seal. Disconnect the shop air as soon as the seal assembly is out. SEE FIGURE 25.

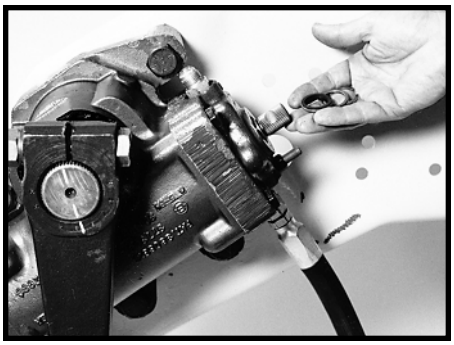


Figure 25

install seal package

2.7 Apply clean grease to the new input shaft seal assembly (7 and 8), the washer (6) and to the input shaft. Install the new two-piece seal (7 and 8) flat side up and the steel backup washer (6), using seal driving tool J26653. SEE FIGURE 26. Install the retaining ring (5).

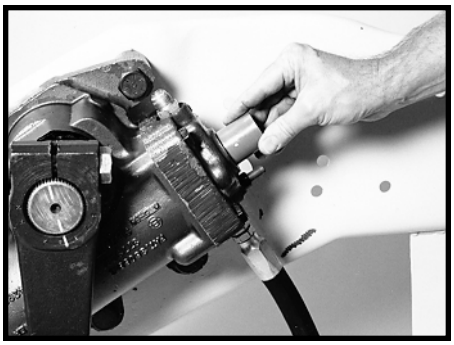


Figure 26

grease input shaft

2.8 Pack the area around the input shaft with high temperature industrial grease per Ross specification 045231, *Mobil Temp 1 or 2 equivalent. SEE FIGURE 27.

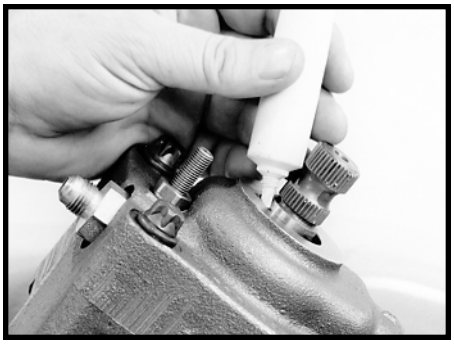


Figure 27

install dirt and water seal

2.9 Install the new dirt and water seal (4) onto the input shaft (17) with the part number facing out. Use tool J26654 or a suitable blunt-ended drift to press the seal into its counter bore. SEE FIGURE 28. If the new seal has a sealing lip on the O.D., it must be against the valve housing (9) face. If the new seal does not have a lip on the O.D., the outer end of the seal must be flush with valve housing face.

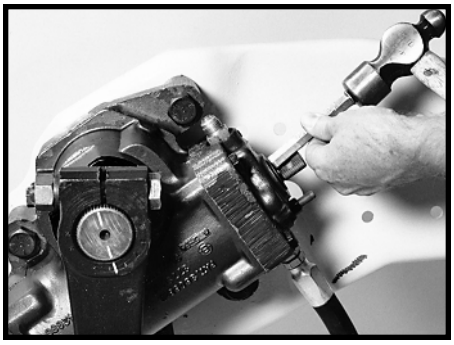


Figure 28

*Mobil Temp is a Registered Trademark of Mobil Oil Co.

assemble seal protector

2.10 Add more grease to seal area and assemble seal protector (63) onto worm shaft/input shaft (17), seating it in the relief groove just beyond the input sift serrations, with cup side toward the gear. SEE FIGURE 29.

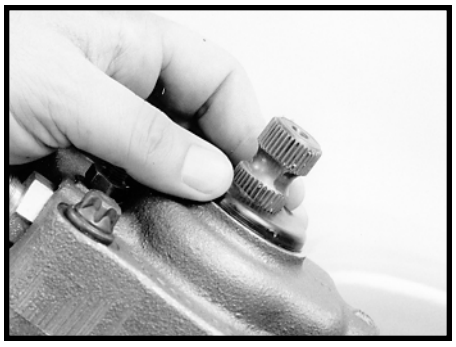


Figure 29

reconnect line

2.11 Remove the plug and reconnect the return line.

reconnect input coupling

2.12 Reconnect the input coupling. If the input coupling male assembly slides free of the female end during reassembly, realign the timing marks to insure proper phasing of the U-joints. Refer to vehicle manufacturer for recommended torque.

WARNING

WARNING: MISTIMED U JOINTS CAN RESULT IN A BUMPY SENSATION AT THE STEERING WHEEL AND POSSIBLY AFFECT STEERING CONTROL.

fill and bleed system

2.13 Before operating the steering gear, fill the system with the recommended fluid and bleed air from the system by following the Filling and Air Bleeding instructions on page 50.

Adjustments

You can make three adjustments to the gear while it is mounted on the vehicle; the worm shaft preload adjustment, the poppet valve adjustment if your gear is equipped with poppets, and the sector shaft adjustment.

3 Worm Shaft Preload Adjustment

(With vehicle engine off)

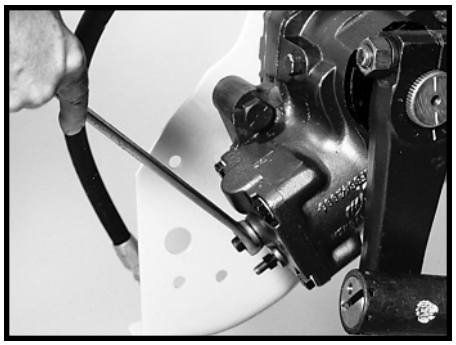


Figure 30

loosen sealing nut and adjusting screw

3.1 Back off the worm shaft adjusting screw sealing nut (38) three turns. SEE FIGURE 30. Back off the worm shaft preload adjusting screw (39) one turn. SEE FIGURE 31. Inspect the threads between the sealing nut and housing end (or end cover, 37, if equipped) for foreign matter. Clean the threads and replace the sealing nut if necessary. SEE FIGURE 32. One and 1/16 inch socket required.

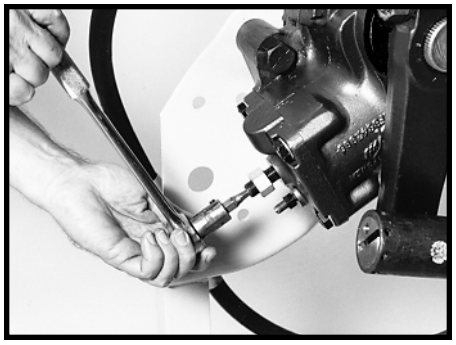


Figure 31

NOTE

NOTE: HFB64 gears are equipped with a housing that has either a closed, nonremovable end or a removable end cover (37). The worm shaft preload adjustment described here applies in either case, and you should make the adjustment according to the instructions in this manual.

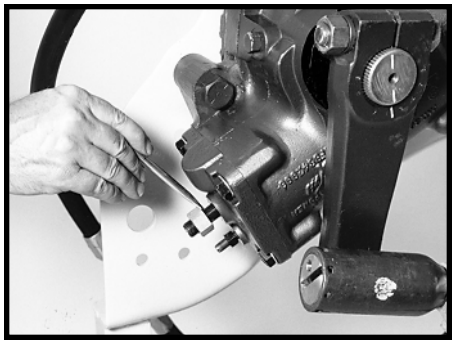


Figure 32

torque adjusting screw

3.2 While someone lightly rotates the steering wheel back and forth about one inch total, torque the worm shaft preload adjusting screw (39) to 60-70 in. lbs. (4.13-4.33 N m). SEE FIGURE 33. 5/16 inch allen or screwdriver socket required.

NOTE

NOTE: While torquing the adjusting screw, make sure that the worm shaft adjusting screw sealing nut (38) does not tighten against housing or cover.

torque sealing nut

3.3 Torque the worm shaft adjusting screw sealing nut (38) to 70-80 ft. lbs. (95-108 N m), making sure that the worm shaft preload adjusting screw (39) does not move.

NOTE

NOTE: If the sealing material in the sealing nut has separated, remove the adjusting screw and replace the sealing nut with a new one onto the nonslotted end of the adjusting screw. Then, assemble and adjust the assembly as described.

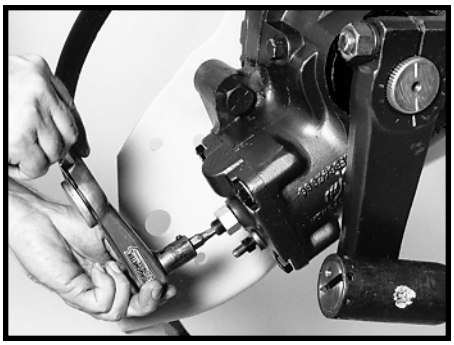


Figure 33

4 Poppet Valve Adjustment

(With vehicle engine on)

NOTE

NOTE: This adjustment is for all HFB64 gears equipped with poppet (unloading) valves, whether they are also equipped with a relief valve or not.

set axle stops

4.1 Before you adjust the poppets, set the axle stops according to the manufacturer's specifications.

install flow meter

4.2 Install a pressure gage or a flow meter/pressure gage package into the supply line from the pump to the gear. Make sure that the flow meter can be pressurized. Bring the fluid temperature to between 125¡F and 135¡F (51.7¡C and 57.2¡C), using the method to warm the system up described in the troubleshooting section, page 7.

rotate sector shaft

4.3 With the engine at idle, have someone turn the steering wheel to full lock (axle against axle stop), while you observe the rotation of the sector shaft (50) SEE FIGURE 34. If the sector shaft rotates counter-clockwise as shown, adjust the poppet adjusting screw identified in FIGURE 34. If the sector shaft rotates clockwise, adjust the other poppet adjusting screw.

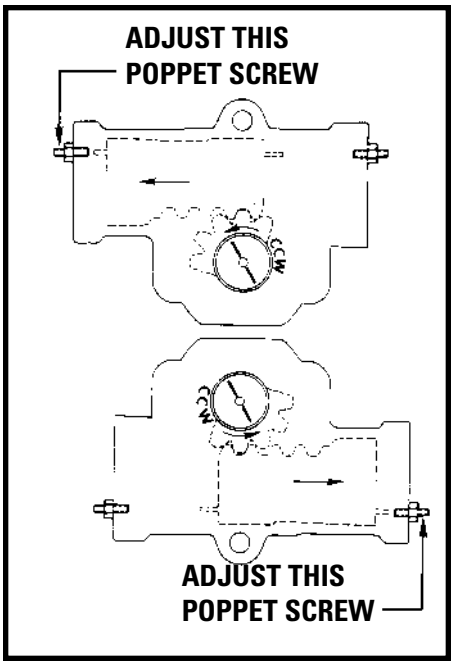


Figure 34

CAUTION

CAUTION: If relief pressure is reached while the steering wheel is at full lock (axle against axle stop), release the steering wheel from this position. At no time should relief pressure be maintained for longer than 5 seconds as damage to the pump may result.

NOTE

NOTE: You must maintain enough force on the steering wheel to assure that the steering gear control valve is completely closed when reading pressure gage.

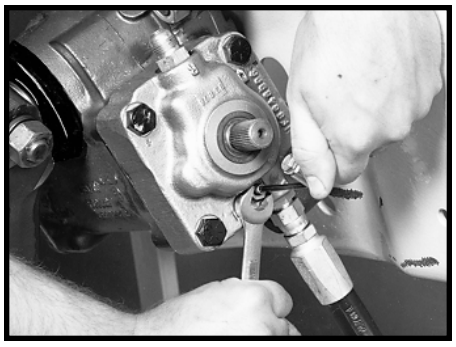


Figure 35

loosen sealing nut and adjusting screw

4.4 Once you have determined which poppet to adjust, loosen the poppet adjusting screw sealing nut (3 or 3A) and the poppet adjusting screw (2, 2A or 40) until the pressure gage reads maximum system (pump) pressure with steering wheel at full lock. SEE FIGURE 35.

CAUTION

CAUTION: If the HFB64 steering gear assembly has a 5/16-24 UNF-2A poppet adjusting screw (2A) in the valve housing (9), the screw cannot be removed from the assembled valve housing because the screw end inside of gear is enlarged. SEE FIGURE 36. This screw, found only in the valve housing, can only be removed, if required, by following the valve housing disassembly procedures.

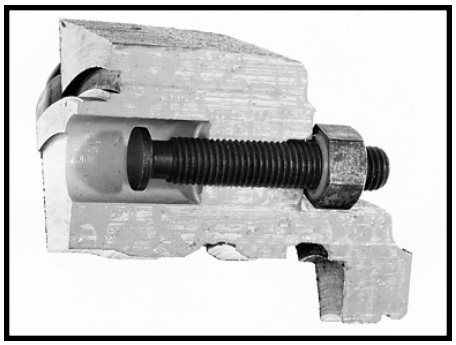


Figure 36

set adjusting screw & tighten sealing nut

4.5 Manually (no power tool) and carefully screw in the poppet adjusting screw (2, 2A or 40) until the pressure gage shows 2 significant drop in pressure, 200-400 psi (13.8-27.6 BAR) with the steering gear against the axle stops. Tighten the poppet adjusting screw sealing nut (3) which has 3/8-24 threads to 12-18 ft. lbs. (16-24 N m). 11/16 inch socket required. Tighten the poppet adjusting screw sealing nut (3A) which has 5/16-24 threads to 8-11 ft. lbs. (11-15 N m). 9/16 inch socket required.

adjust other poppet

4.6 To adjust the other poppet, repeat these instructions for full lock in the other direction. SEE FIGURE 37.

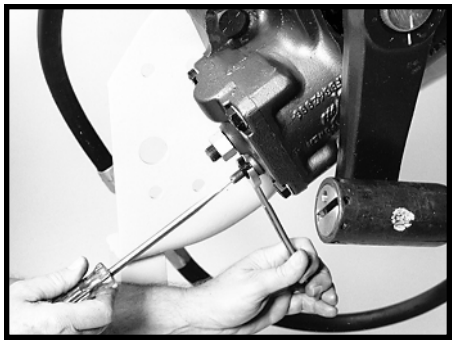


Figure 37

5 Cross-shaft or Sector-shaft Adjustment

(With vehicle engine off)

locate adjusting nut

5.1 If the sector-shaft adjusting screw jam nut (59), located on the side cover, is not accessible, the steering gear must be removed prior to adjustment.

remove the drag link

5.2 If the sector shaft adjusting screw (51) is accessible, remove the drag link from the pitman arm.

CAUTION

CAUTION: This adjustment must be performed with the sector shaft on its center of travel.

NOTE

NOTE: Because of pitman arm or internal stops or poppet adjustment the "center of travel" for this adjustment may not be the center of sector shaft or handwheel rotation.

center the sector shaft

5.3 To position the sector shaft (50) on center of travel for this adjustment rotate steering wheel (worm shaft/input shaft) until the timing mark across the end of the sector shaft is perpendicular to the worm shaft/input shaft 117). SEE FIGURE 38, page 20.

check for lash

5.4 With the sector shaft (50) in the center position, grasp the pitman arm and gently try to move this arm back and forth in the direction of travel. Finger-tip force is adequate to detect lash of a loose sector shaft. There must be no movement of the input shaft or sector shaft. If no lash is detected, do not adjust.

position adjusting screw

5.5 If lash is detected, loosen jam nut (59) with a 3/4 inch socket and move the adjusting screw (51) clockwise until the sector shaft and rack piston (31) are in contact. [Use no more than 10 ft. lbs. (14 N m) of torque]. Then, turn the adjusting screw counterclockwise one turn.

check for lash

5.6 At this point, there should be lash at the pitman arm.

eliminate lash

5.7 To adjust, slowly turn the adjusting screw (51) clockwise until no lash is felt at the pitman arm. Hold the adjusting screw in place, and tighten the jam nut (59). Final torque 40-45 ft. lbs. (54-61 N m).

recheck for lash

5.8 Recheck the pitman arm for lash. Turn the steering wheel 1/4 turn each side of center. No lash should be felt. If lash exists, repeat adjustments 5.3-5.8.

connect drag link

5.9 Re-connect drag link to pitman arm.

HFB64 Exploded Assembly View-Typical (Identical to page 19 C)

ITEM NO.

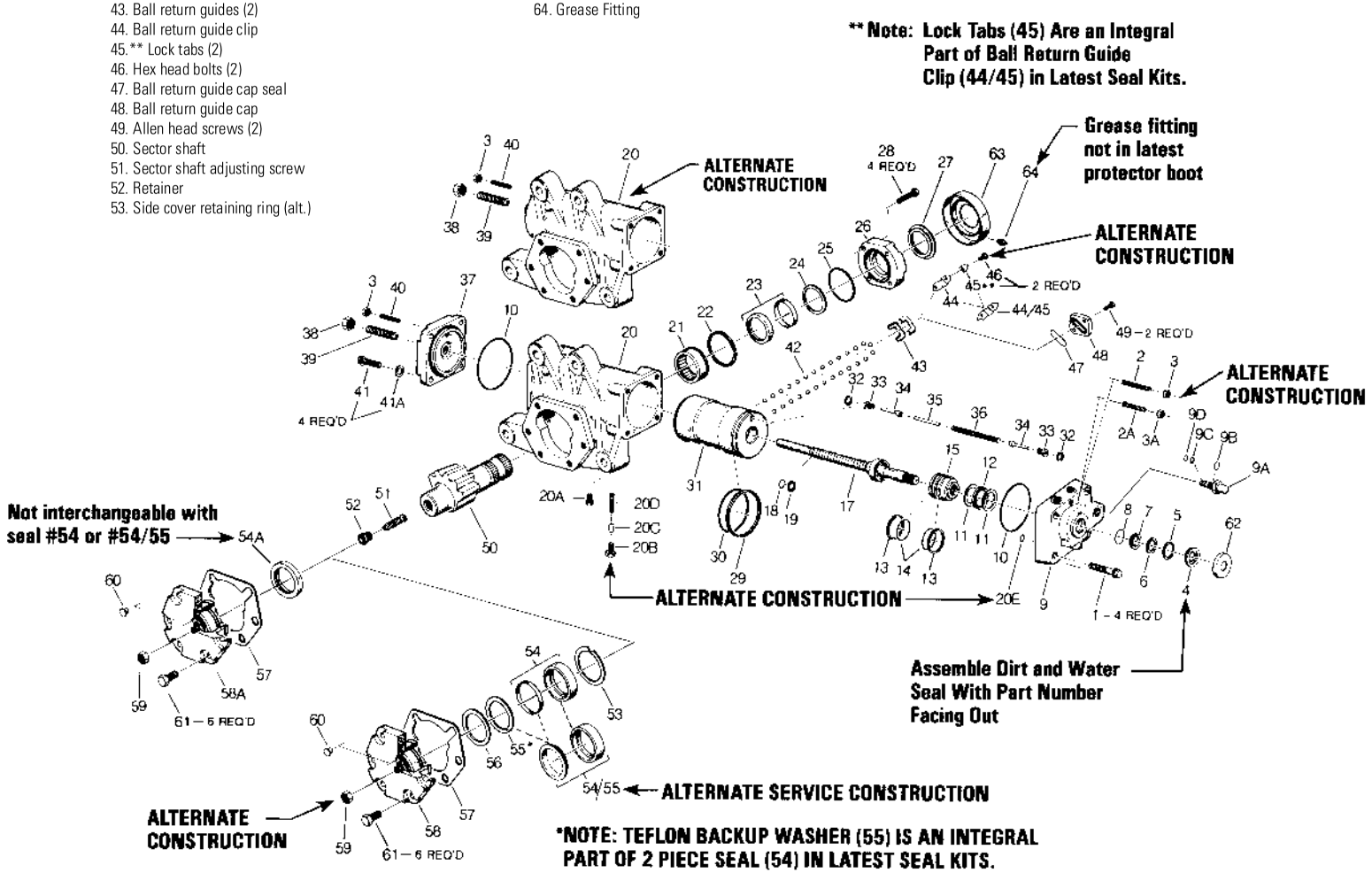
1. Valve housing bolts (4)
2. Poppet adjusting screw
2A. Allen Head Hex Poppet Adjusting Screw
3. Poppet adjusting screw sealing nut
3A. Poppet adjusting screw sealing nut
4. Dirt and water seal
5. Retaining ring
6. Steel backup washer
7. Input shaft seal
8. Input shaft O-ring
9. Valve housing
9A. Relief valve
9B. Large O-ring
9C. Teflon seal ring
9D. Small O-ring
10. Seal rings (2)
11. Thrust washers (21
12. Thrust bearing
13. Teflon seal rings (2)
14. Backup O rings (2)
15. Valve sleeve
17. Worm shaft/input shaft
18. Worm shaft backup O-ring
19. Teflon worm shaft seal ring
20. Gear housing
20A. Manual bleed screw
20B. Automatic bleed screw
20C. Special pin
20D. Spring
20E. Automatic Bleed Passage Way Seal
21. Housing bearing
22. Retaining ring
23. Two-piece sector shaft seal
24 Teflon backup washer
25. Trunnion cover seal ring
26. Trunnion cover
27. Dirt and water seal
28. Trunnion cover bolts (4)
29. Teflon rack piston seal ring
30. Rack piston backup O-ring
31. Rack piston

ITEM NO.

32. Poppet retaining rings (2)
33. Poppet seats (2)
34. Poppets (2)
35. Nylon spacer rod
36. Poppet spring
37. End cover
38. Worm shaft adjusting screw Sealing nut
39. Worm shaft adjusting screw
40. Poppet adjusting screw
41. End cover bolts (4)
41A Washers (4)
42. Steel balls (27)
43. Ball return guides (2)
44. Ball return guide clip
45.** Lock tabs (2)
46. Hex head bolts (2)
47. Ball return guide cap seal
48. Ball return guide cap
49. Allen head screws (2)
50. Sector shaft
51. Sector shaft adjusting screw
52. Retainer
53. Side cover retaining ring (alt.)

ITEM NO.

54. Two-piece side cover seal (alt.)
54A. Seal
55.* Teflon backup washer (alt.)
56. Steel backup washer (alt.)
57. Side cover gasket
58. Side cover (alt.)
58A. Side cover
59. Sector shaft adjusting screw jam nut
60. Vent plug
61. Special bolts (6)
62. Seal Protector
63. Seal Protector Boot
64. Grease Fitting


** Note: Lock Tabs (45) Are an Integral Part of Ball Return Guide Clip (44/45) in Latest Seal Kits.
Grease fitting not in latest protector boot
ALTERNATE CONSTRUCTION
ALTERNATE CONSTRUCTION
ALTERNATE CONSTRUCTION
Not interchangeable with seal #54 or #54/55
ALTERNATE CONSTRUCTION
Assemble Dirt and Water Seal With Part Number Facing Out
54/55 ALTERNATE SERVICE CONSTRUCTION
ALTERNATE CONSTRUCTION
*NOTE: TEFLON BACKUP WASHER (55) IS AN INTEGRAL PART OF 2 PIECE SEAL (54) IN LATEST SEAL KITS.

HFB64 Exploded Assembly View-Typical (Identical to page 19 B)

ITEM NO.

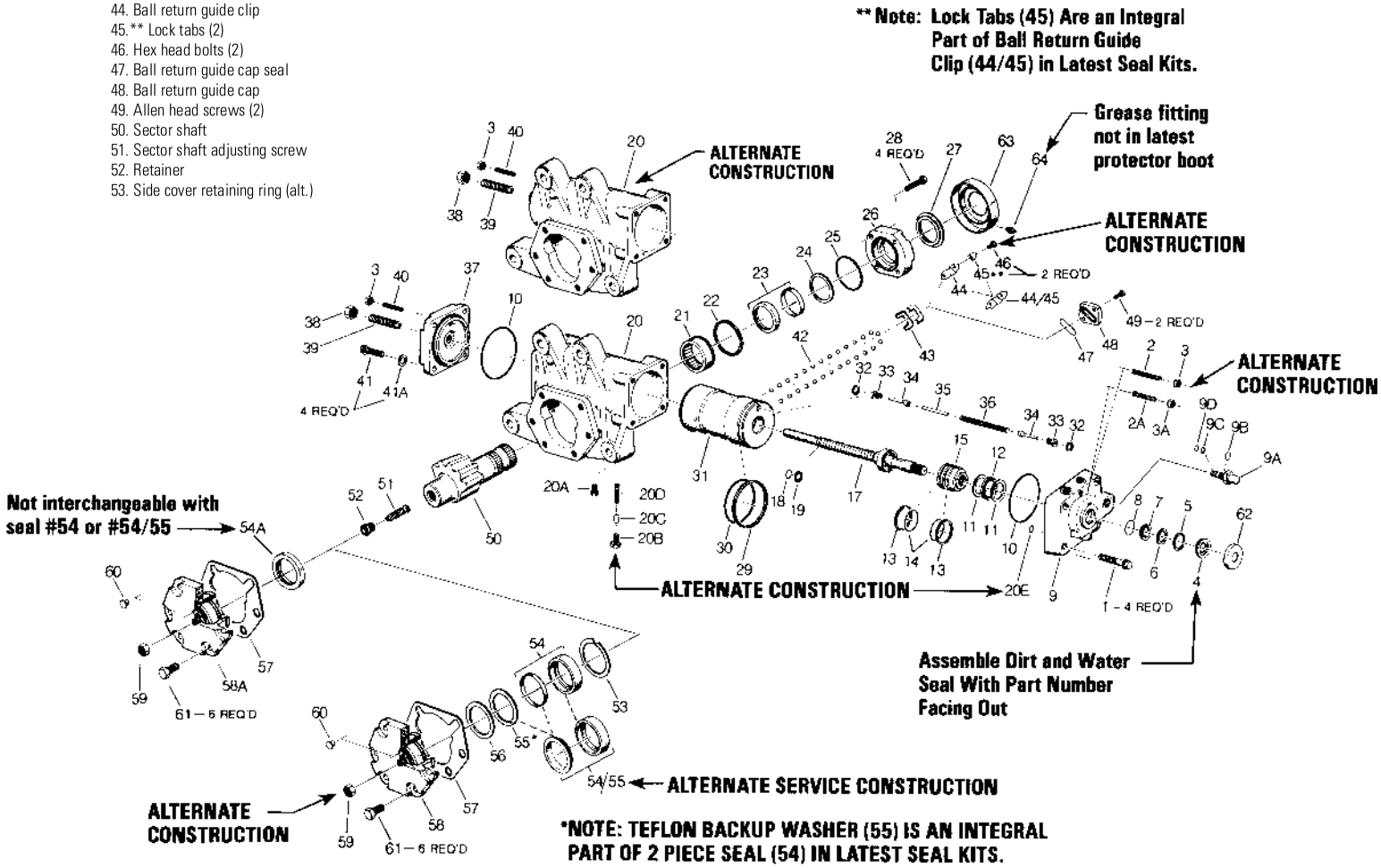
1. Valve housing bolts (4)
2. Poppet adjusting screw
2A. Allen Head Hex Poppet Adjusting Screw
3. Poppet adjusting screw sealing nut
3A. Poppet adjusting screw sealing nut
4. Dirt and water seal
5. Retaining ring
6. Steel backup washer
7. Input shaft seal
8. Input shaft O-ring
9. Valve housing
9A. Relief valve
9B. Large O-ring
9C. Teflon seal ring
9D. Small O-ring
10. Seal rings (2)
11. Thrust washers (21
12. Thrust bearing
13. Teflon seal rings (2)
14. Backup O rings (2)
15. Valve sleeve
17. Worm shaft/input shaft
18. Worm shaft backup O-ring
19. Teflon worm shaft seal ring
20. Gear housing
20A. Manual bleed screw
20B. Automatic bleed screw
20C. Special pin
20D. Spring
20E. Automatic Bleed Passage Way Seal
21. Housing bearing
22. Retaining ring
23. Two-piece sector shaft seal
24 Teflon backup washer
25. Trunnion cover seal ring
26. Trunnion cover
27. Dirt and water seal
28. Trunnion cover bolts (4)
29. Teflon rack piston seal ring
30. Rack piston backup O-ring
31. Rack piston

ITEM NO.

32. Poppet retaining rings (2)
33. Poppet seats (2)
34. Poppets (2)
35. Nylon spacer rod
36. Poppet spring
37. End cover
38. Worm shaft adjusting screw Sealing nut
39. Worm shaft adjusting screw
40. Poppet adjusting screw
41. End cover bolts (4)
41A Washers (4)
42. Steel balls (27)
43. Ball return guides (2)
44. Ball return guide clip
45.** Lock tabs (2)
46. Hex head bolts (2)
47. Ball return guide cap seal
48. Ball return guide cap
49. Allen head screws (2)
50. Sector shaft
51. Sector shaft adjusting screw
52. Retainer
53. Side cover retaining ring (alt.)

ITEM NO.

54. Two-piece side cover seal (alt.)
54A. Seal
55.* Teflon backup washer (alt.)
56. Steel backup washer (alt.)
57. Side cover gasket
58. Side cover (alt.)
58A. Side cover
59. Sector shaft adjusting screw jam nut
60. Vent plug
61. Special bolts (6)
62. Seal Protector
63. Seal Protector Boot
64. Grease Fitting


** Note: Lock Tabs (45) Are an Integral Part of Ball Return Guide Clip (44/45) in Latest Seal Kits.
Grease fitting not in latest protector boot
ALTERNATE CONSTRUCTION
ALTERNATE CONSTRUCTION
ALTERNATE CONSTRUCTION
Not interchangeable with seal #54 or #54/55
54A
ALTERNATE CONSTRUCTION
20E
Assemble Dirt and Water Seal With Part Number Facing Out
54/55 ALTERNATE SERVICE CONSTRUCTION
ALTERNATE CONSTRUCTION
*NOTE: TEFLON BACKUP WASHER (55) IS AN INTEGRAL PART OF 2 PIECE SEAL (54) IN LATEST SEAL KITS.

Torque Chart

Part Name	Item Number	Torque
Valve housing bolts (4)	1	105-115 ft. lbs. (142-156 Nm)
Valve housing bolts (4)	1 if lubricated	75-85 ft. lbs. (102-115 Nm)
Poppet adjusting screw sealing nut		
-3/8-24	3	12-18 ft. lbs. (16-24 Nm)
-5/16-24	3A	8-11 ft. lbs. (11-15 N m)
Relief valve	9A	25-35 ft. lbs. (34-48 N m)
Manual bleed screw	20A	27-33 in lbs. (3.1-3.7 N m)
Automatic bleed screw	20B	16-20 ft. lbs. (22-27 N m)
Auxiliary cylinder fittings	-	25-35 ft. lbs. (34-48 N m)
Trunnion cover bolts (4)	28	15-22 ft. lbs. (20-30 N m)
Trunnion cover bolts (4)	28 if lubricated	11-16 ft. lbs. (15-22 N m)
Poppet seat	33	20-25 ft. lbs. (27-34 N m)
Worm shaft adjusting screw sealing nut	38	70-8- ft. lbs. (95-108 N m)
Worm shaft preload adjusting screw	39	60-7- in. lbs. (6.8-7.9 N m)
End cover bolts (4)	41	105-115 ft. lbs. (142-156 N m)
End cover bolts (4)	41if lubricated	75-85 ft. lbs. (102-115 N m)
Hex head bolts (2)	46	14-22 ft. lbs. (19-30 N m)
Allen or Torx head screws (2)	49	14-22 ft. lbs. (19-30 N m)
Sector shaft adjusting screw	59	40-45 ft. lbs. (54-61 N m)
Special bolts (6)	61	220-240 ft. lbs. (298-325 N m)
Special bolts (6)	61 if lubricated	160-180 ft. lbs. (217-244 N m)
Pitman arm clamp bolt	lubed or plated	300-320 ft. lbs. (407-434 N m)
Pitman arm clamp bolt	dry/unplated	380-420 ft. lbs. (515-569 N m)

Universal joint bolts - torque to vehicle manufacturer's specifications.

All torque values in this manual are for dry/unplated parts unless otherwise specified.

Tools and Materials Required for Servicing

Service manual
Masking tape
Grease - **Mobil Temp 1 or 2 or equivalent
Wheel bearing grease
Adjustable wrench
Pocket knife
Torque wrench - in. lbs. (N m)
Torque wrench 0 ft. lbs. (N m)
Soft punch
Rubber mallet
Allen wrench set
Vise
Retaining pliers
Breaker bar
Ratchet
Sockets: 5/16, 1/2, 9/16, 11/16, 3/4
15/16, 1 and 1 1/16 inch
Allen sockets: 5/32, 3/16, 5/16 inch
12-point sockets: 11/16 and 3/4 inch
Torx sockets: T-30, E-10, E-16
Pitman arm puller
Screwdriver
Slot type screwdriver socket
Chisel
Box end wrenches: 9/16, 11/16, 1 1/16 inch
Rolling head prybar (ladyfoot)
1/2-20 UNF 2A x 3 inch bolt

Special Tools*

Complete Tool Kit	J26872	Seal Driving Tool	J26653
Seal Installation Tool	J26650-01	Seal Driving Tool	J26654
Seal Compression Tool	J26649	Relief Valve Plug	J29059
Seal Installation Tool	J26647	Bearing & Seal Tool	J37071
Seal Compression Tool	J26648		

*Special Tools Available From:
Kent-Moore Tool Division
29784 Little Mack
Roseville, MI 48066
Phone: 313-774-9500
TELEX: 23-5377

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Disassembly

Preparation

- ∫ THOROUGHLY CLEAN OFF ALL OUTSIDE DIRT, ESPECIALLY FROM AROUND FITTINGS AND HOSE CONNECTIONS, BEFORE YOU REMOVE THE GEAR.
- ∫ Drain the steering gear assembly.
- ∫ Remove input and output shaft connections per 1.1 and 2.1, Page 11 and 14.
- ∫ Remove the supply and return lines from the gear, and immediately plug all port holes and fluid lines.

WARNING: THIS STEERING GEAR WEIGHS APPROXIMATELY 80 POUNDS 36 KG DRY. EXERCISE CAUTION WHEN YOU REMOVE, LIFT, OR CARRY IT. DO NOT POUND THE UNIVERSAL JOINT OR INPUT SHAFT COUPLING ON OR OFF THE INPUT SHAFT. INTERNAL DAMAGE TO THE STEERING GEAR CAN RESULT.

- ∫ Remove the steering gear from the vehicle and take it to a clean surface (a piece of wrapping paper makes an excellent disposable top).
- ∫ Clean and dry the gear before you start to disassemble it.
- ∫ As you disassemble the gear, clean all parts in clean, petroleum-based solvent, and blow them dry only.

WARNING: SINCE THEY ARE FLAMMABLE, BE EXTREMELY CAREFUL WHEN USING ANY SOLVENT. EVEN A SMALL EXPLOSION OR FIRE COULD CAUSE INJURY OR DEATH.

WARNING: WEAR EYE PROTECTION AND BE SURE TO COMPLY WITH OSHA OR OTHER MAXIMUM AIR PRESSURE REQUIREMENTS.

CAUTION: Never steam clean or high-pressure wash hydraulic steering components. Do not force or abuse closely fitted parts.

- ∫ Keep each part separate to avoid nicks and burrs.
- ∫ Discard all seals, 0-rings, and gaskets removed from the gear. Replace them with new parts only.

Disassembly

position gear and sector shaft

1. Position the steering gear firmly in a vise with the gear's worm shaft/input shaft (17) in a horizontal direction. Prepare for fluid drainage and unplug fluid line ports. Rotate worm shaft/input shaft with an 11/16 inch or 3/4 inch 12 point socket or box end wrench, through the gear travel several times to purge hydraulic fluid from the unit. Then position the timing mark located on the end of the sector shaft to a vertical direction. SEE FIGURE 38.

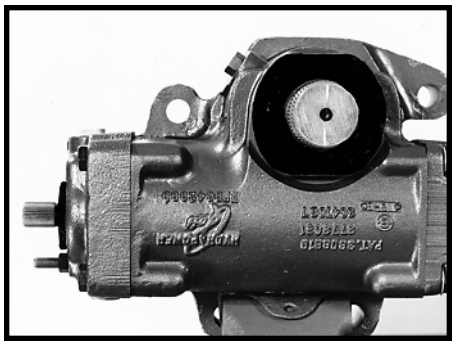

Figure 38

remove protector boot & dirt and water seal

2. Remove the seal protector boot (63), grease fitting (64) if included and the dirt and water seal (27) from the trunnion cover (26). SEE FIGURE 39. Discard protector boot and seal.

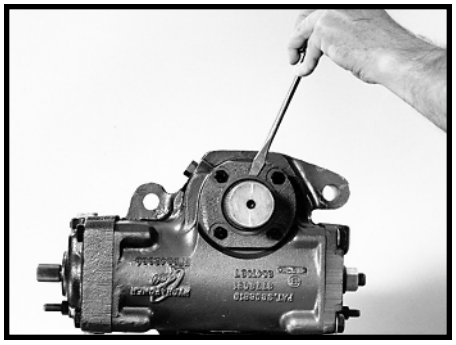

Figure 39

clean sector shaft and loosen jam nut

3. Remove any paint or corrosion from the nonserrated area of the sector shaft (50) (as in 1.3, Page 11), and loosen the sector shaft adjusting screw jam nut (59).

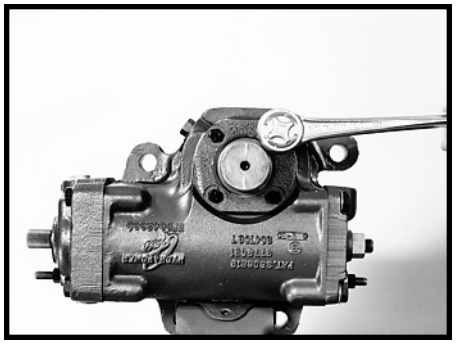

Figure 40

remove trunnion cover bolts

4. Remove the four trunnion cover bolts 1281 with a 1/2 inch socket. SEE FIGURE 40.

remove trunnion cover and seal package

5. Remove the trunnion cover (26). Remove and discard the seal ring (25), the two piece sector shaft seal (23) and the Teflon back-up washer (24) from the trunnion cover. SEE FIGURE 41.

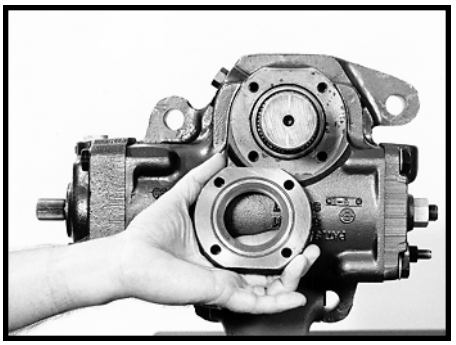

Figure 41

tape sector shaft

6. Tape the serrations and bolt groove of the sector shaft (50) with one layer of masking tape to prevent loose bearing rolls from "hanging up" the sector shaft during its removal. SEE FIGURE 42. The tape should not extend on to the sector shaft bearing diameter.

Figure 42

remove side cover bolts

7. Prepare for fluid to drain, and remove the six special bolts (61) from the side cover (58) with a 15/16 inch socket. SEE FIGURE 43.

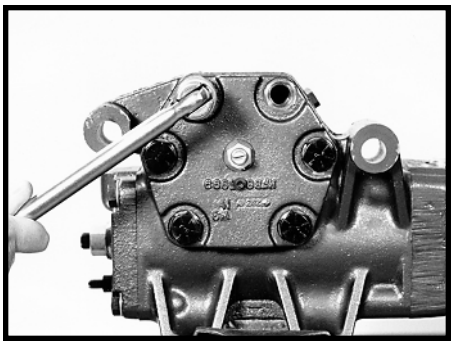

Figure 43

NOTE

NOTE: These bolts are special because they are equipped with either a ring or washer design on the underside of the head. SEE FIGURE 44. If you replace one or more bolts, you must use bolts of either design and of the SAME SPECIAL TYPE AND LENGTH AS THOSE YOU REMOVED. Do not use a substitute. You can get these bolts through your OEM parts distributor.

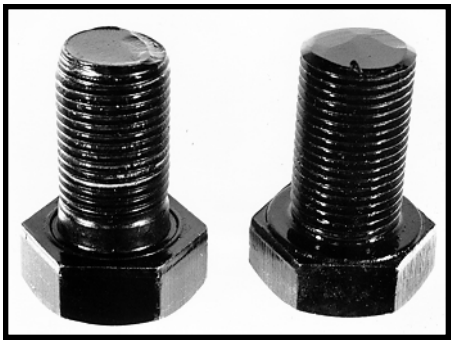

Figure 44

begin to remove side cover

8. Begin to remove the side cover (58) and sector shaft (50) as an assembly. SEE FIGURE 45. Stop removal when the bearing rolls in the housing bearing (21) are half exposed. Coat the bearing rolls with grease. As a means of starting the removal of the side cover and sector shaft assembly, you may use a soft hammer or wooden hammer handle.

NOTE

NOTE: When the bearing rolls are half exposed and it is evident that the unit has a caged bearing (rolls retained), the following two notes do not apply.

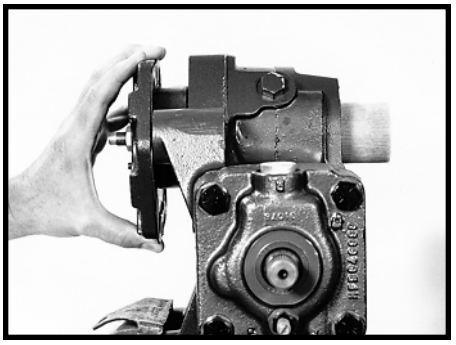

Figure 45

NOTE

NOTE: Take care to remove this assembly slowly, or it may come out too quickly for you to retain the bearing rolls in the housing bearing race. Follow the shaft end with the bearing tool (J26738) to retain the rolls, or when the rolls are half exposed, be sure to coat them with grease to retain them in the housing bearing. SEE FIGURE 46.

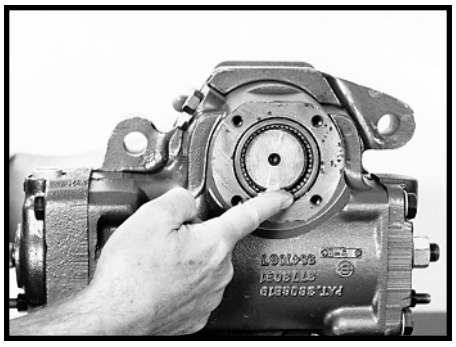

Figure 46

CAUTION

CAUTION: If one or more of the rolls is lost, you must replace the entire bearing (see disassembly step 41). If the bearing is identified as BR-866-1 or is not identified, there are 44 rolls. If the bearing is identified as F83508, there are 43 rolls. The number on the housing bearing may not be visible while it is in place, so take care to insure that no rolls are lost during disassembly or assembly

remove side cover and sector shaft

9. Finish removing the side cover (58) and sector shaft (50) as an assembly. Remove side cover gasket (57) and discard.

remove bearing rolls

10. If the housing bearing has loose rolls, remove the bearing rolls from the bearing (21) race, count them and put them aside as a set for cleaning, inspecting and reassembly

remove jam nut

11. Remove the sector shaft adjusting screw jam nut (59). SEE FIGURE 47. 3/4 inch socket required.

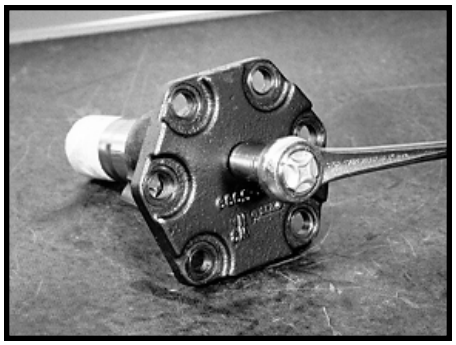

Figure 47

NOTE

NOTE: A side cover (58A) will have a "DU" bushing and once piece seal (54A). A side cover (58) will have a "DU" bushing or a roller bearing, steel back up washer (56) teflon backup washer (55), two piece seal (54) and retaining ring (53). The side cover roller bearing can have retained (caged) or loose rollers. The teflon backup washer (55) and two piece seal (54) may have been replaced with an integral washer and seal (54/55). See exploded assembly view.

remove sector shaft from side cover

12. Screw the sector shaft adjusting screw (51) through the side cover (58 or 58A). SEE FIGURE 48. Place the side cover exterior side down and lift the sector shaft out vertically. SEE FIGURE 49.

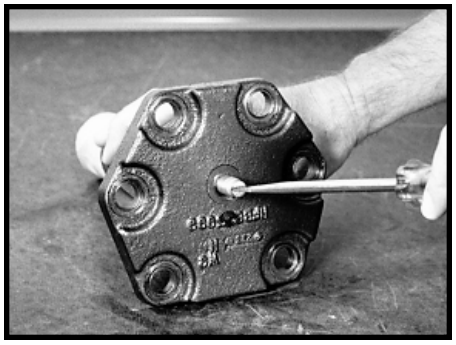

Figure48

NOTE

NOTE: If the side cover bearing assembly has uncaged (loose) rolls, the vertical position will allow the side cover bearing rolls to fall into the side cover, where you may easily collect and count them. The bearing with no identification or identified as BR-866-1 will have 44 rolls. The bearing identified as F83508 will have 43 rolls.

Figure 49

CAUTION

CAUTION: The part number of the bearing in the side cover may not be visible on the surface. Take care not to lose any rollers during disassembly and assembly, or you will have to replace the complete side cover assembly.

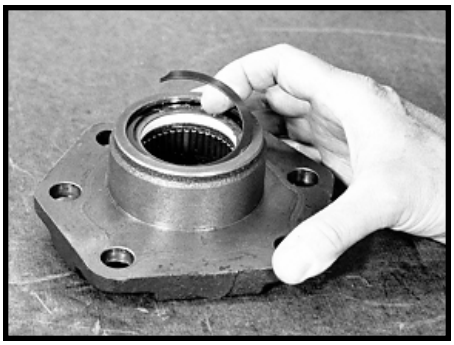

Figure 50

WARNING

WARNING: IF THE BEARING IS THE UNCAGED (LOOSE) ROLL TYPE, DO NOT MIX THE ROLLS FROM THE SIDE COVER WITH THE ROLLS FROM THE HOUSING BEARING. THE BEARING RACE AND ROLLS ARE A MATCHED SET. INTERCHANGING THE ROLLS COULD RESULT IN PREMATURE BEARING OR SEAL FAILURE, WHICH COULD CAUSE A LOSS OF POWER STEERING.

remove side cover seal package

13. If included, remove the side cover retaining ring (53), the two-piece side cover seal (54), the Teflon backup washer (55), and the steel backup washer (56) from the side cover (58) SEE FIGURES 50 & 51. Discard the two-piece seal and the Teflon backup washer.

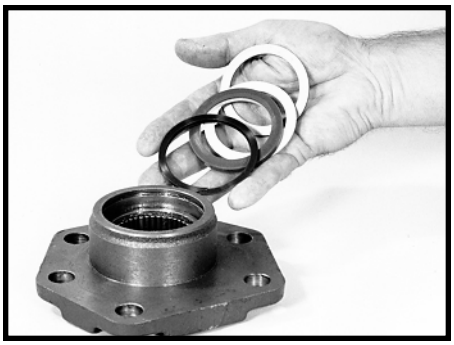

Figure 51

Or if seal (54A) is to be removed, clamp side cover (58A) in a vise as shown. Screw a 1/2-20 UNF 2A x 3" bolt into the side cover adjusting screw hole so that the bolt end is at a position that will support a rolling head (ladyfoot) type pry bar. With the pry bar supported on the bolt end, pry seal out of the side cover. Discard seal and remove bolt. SEE FIGURE 51A. Remove and discard vent plug (60).

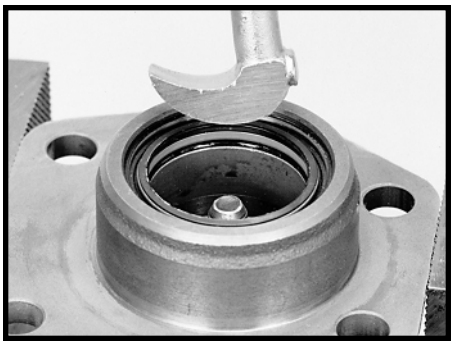

Figure 51A

CAUTION

CAUTION: Exercise special care when removing seal (54A) to prevent damaging the cover seal bore or "DU" bushing.

remove retainer and adjusting screw

14. Only if replacement of the retainer (52) and or adjusting screw (51) is required (see inspection procedure 8 page 32), place the sector shaft (50) firmly in a soft jawed vise and unstake the retainer using a suitable chisel. Turn the retainer out of the sector shaft pocket and remove the adjusting screw. Discard the retainer. SEE FIGURE 52.

Figure 52

remove worm shaft adjusting screws and sealing nuts

15. Loosen the worm shaft preload adjusting screw sealing nut (38) with a 1-1/16 inch socket, and loosen the worm shaft preload adjusting screw (39) about two turns with a 5/16 inch Allen socket or screwdriver. SEE FIGURE 53. If your gear is equipped with poppets, loosen the poppet adjusting screw sealing nut (3) and the poppet adjusting screw (40) about two turns. An 11/16 inch hex wrench required.

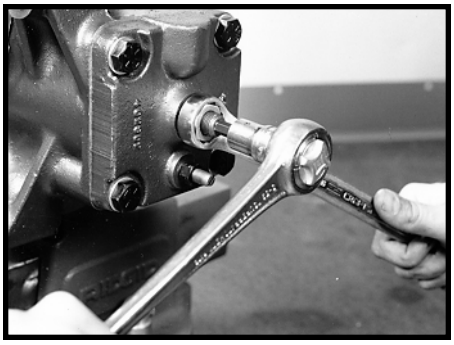

Figure 53

NOTE

NOTE: The worm shaft adjusting screw and sealing nut and poppet adjusting screws and sealing nuts do not have to be removed unless apparent fluid leaks at the adjusting screw or damage indicate the sealing nuts and or screws be replaced.

remove end cover bolts and end cover, if equipped

16. If your gear is equipped with a removable end cover (37), remove the four end cover bolts (41) and washers (41A) with a 13/16 inch hex or E-16 Torx socket. Then prepare for fluid to drain and remove the end cover. SEE FIGURE 54.

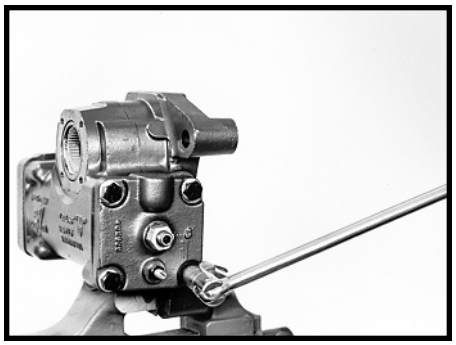

Figure 54

remove end cover seal ring

17. Remove the end cover seal ring (10) from the groove in the end cover (37). SEE FIGURE 55.

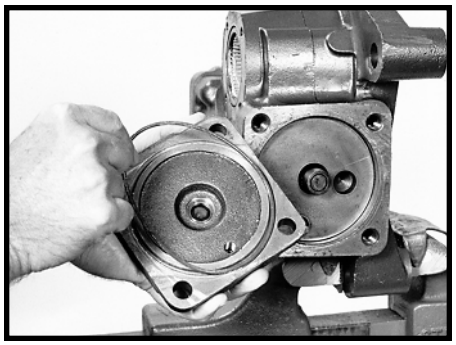

Figure 55

NOTE

NOTE: Gears with the closed end housing do not have an end cover seal ring, end cover bolts or washers.

remove relief valve, if equipped

18. Remove the relief valve (9A), if equipped, from the valve housing (9). SEE FIGURE 56. One inch hex socket required.

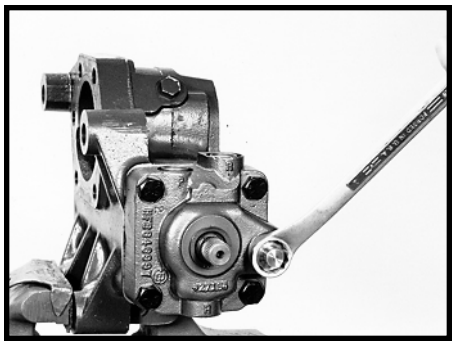

Figure 56

remove relief valve seal pack

19. Remove and discard the two relief valve O-rings (9B and 9D) and the Teflon seal ring (9C) from the relief valve (19A) SEE FIGURE 57.

remove seal protector, clean input shaft

20. Remove and discard seal protector (62) from worm shaft/input shaft (17). Clean any paint or foreign matter from the exposed nonserrated area of the input shaft with a fine grade of emery paper. SEE FIGURE 20 page 14.

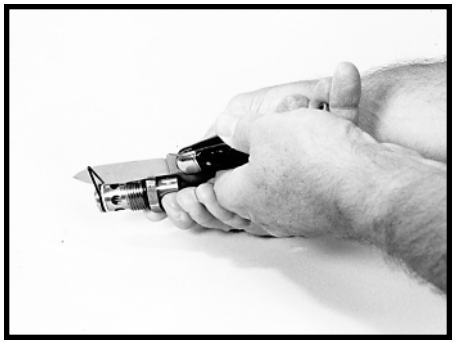

Figure 57

loosen other poppet sealing nut and screw

21. If your gear is so equipped, loosen the other poppet adjusting screw sealing nut (3 or 3A) and the other poppet adjusting screw (2 or 2A) in the valve housing (9) about two turns.

NOTE

NOTE: It is recommended that a line be scribed across the edge of valve housing (9) and gear housing (20) before disassembly of valve housing for correct positioning at reassembly.

remove valve housing bolts and valve housing

22. Remove the four valve housing bolts (1) with a 13/16 inch hex or E-16 Torx socket. Prepare for some fluid to drain, and remove the valve housing (9). SEE FIGURE 58 & 59.

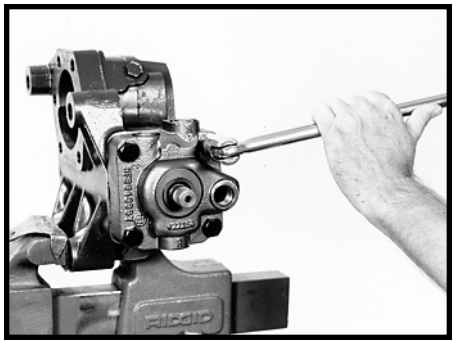

Figure 58

NOTE

NOTE: The valve sleeve (15) will probably remain in the valve housing.

WARNING

WARNING: DO NOT DISASSEMBLE THE WORM SHAFT/INPUT SHAFT ASSEMBLY (17) WHICH INCLUDES THE WORM SHAFT, INPUT SHAFT, TORSION BAR, TORSION BAR PINS, DRIVE RING AND DRIVE RING RETAINER, AND INSERT. DO NOT UNBEND THE DRIVE RING RETAINER TANGS THAT HOLD THE DRIVE RING IN PLACE. SEE FIGURE 60. DOING EITHER WILL ALTER THE VALVE TIMING, WHICH COULD CAUSE THE VEHICLE TO PULL TO ONE SIDE OR THE OTHER.

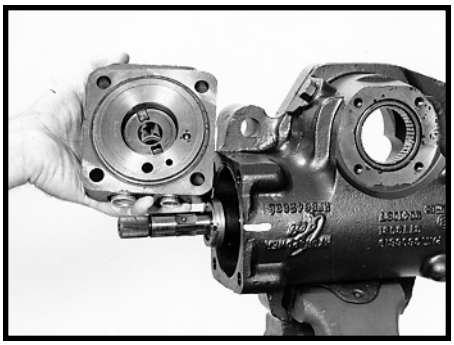

Figure 59

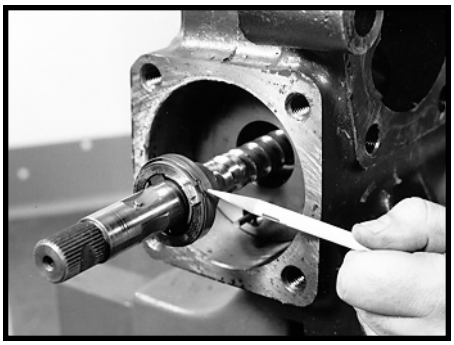

Figure 60

remove valve sleeve

23. Remove the valve sleeve (15) from the valve housing (9). SEE FIGURE 61.

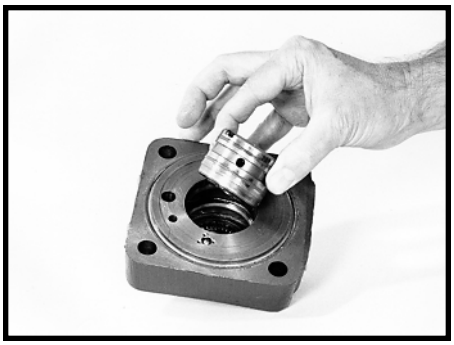

Figure 61

remove thrust washers and bearing

24. Remove the first thrust washer (11), the thrust bearing (12), and the second thrust washer (11) from the valve housing (9). SEE FIGURE 62.

NOTE

NOTE: The first thrust washer may stay on the end of the valve sleeve. If so, remove it from the sleeve.

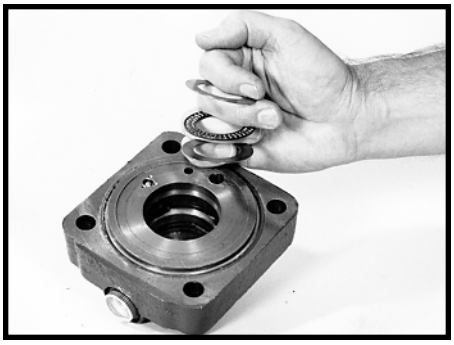

Figure 62

remove seal rings

25. Remove and discard the two Teflon seal rings (13) from the valve sleeve (15). SEE FIGURE 63.

remove O-rings

26. Remove and discard the two backup O-rings (14) from the grooves in the valve sleeve (15).

remove seal ring and O-ring

27. Remove and discard seal ring (10) and, if included, the automatic bleed passage way O-ring (20E) from valve housing (9).

remove dirt and water seal

28. Remove and discard the dirt and water seal (4) SEE FIGURE 64.

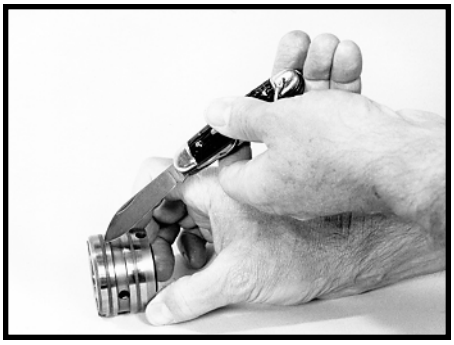

Figure 63

remove retaining ring

29. Remove the retaining ring (5). SEE FIGURE 65.

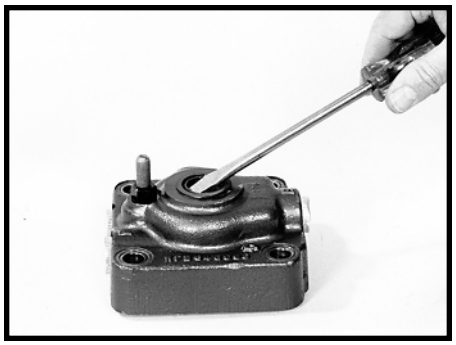

Figure 64

remove valve housing seal package

30. Remove the steel backup washer (6), the input shaft seal (7), and the input shaft O-ring (8) from the valve housing (9). Discard the seal and O-ring. SEE FIGURE 66.

remove poppet adjusting screw and nut

31. Remove poppet adjusting screw (2 or 2A) and nut (3 or 3A) if replacement is required. A 5/16 24-2A UNF adjusting screw (2A) can be removed from the internal face of the valve housing after removing nut (3A) 9/16 or 11/ 16 inch socket required.

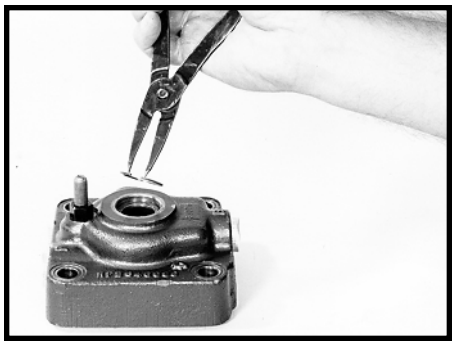

Figure 65

remove rack piston and worm shaft/ input shaft

32. Remove the rack piston (31) and worm shaft/input shaft (17) from the gear housing (20) as an assembly. SEE FIGURE 67. Set the rack piston and worm shaft assembly on a clean rag to keep the piston from rolling.

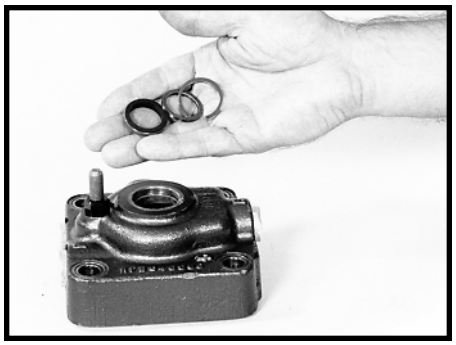

Figure 66

NOTE

NOTE: The worm shaft part of the assembly will be inside the rack piston, with the input shaft part of the worm protruding from the rack. Take care when you remove this assembly from the housing. To prevent the Teflon rack piston seal (29) from getting caught in the sector shaft cavity, remove the assembly from the long end of the housing, if the housing is open on both ends.

NOTE

NOTE: To prevent the Teflon rack piston seal ring (29) from "hanging up" as it exits the housing sector shaft cavity in housings that are closed at the long end of the rack piston bore, cut and remove the seal ring from the rack piston when it is exposed in the sector shaft cavity of the housing, during the removal of worm shaft/input shaft, rack piston assembly.

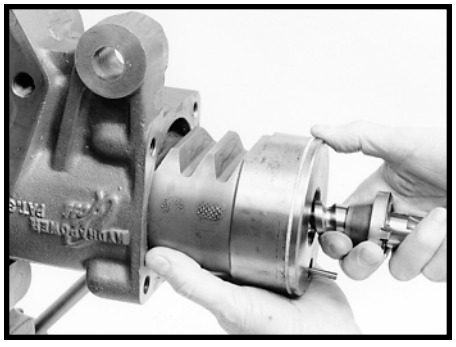

Figure 67

remove ball return guide clip, if equipped

33. For rack pistons with the ball return guide clip (44), bend the tangs down on the two locking tabs (45). SEE FIGURE 68. Remove the two hex head bolts (46), tabs and clip. Discard locking tabs. SEE FIGURE 69. 1/2 inch hex socket required.

NOTE

NOTE: The current HFB64 units and seal kits will utilize a ball return guide clip (44/45) with the two lock tabs integral to it.

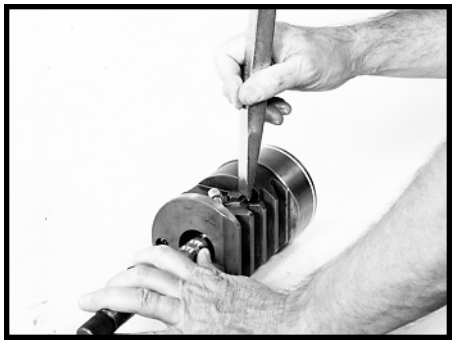

Figure 68

NOTE

NOTE: If the seal kit being used includes a ball return guide clip (44/45) with integral lock tabs, discard the ball return guide clip removed from the unit.

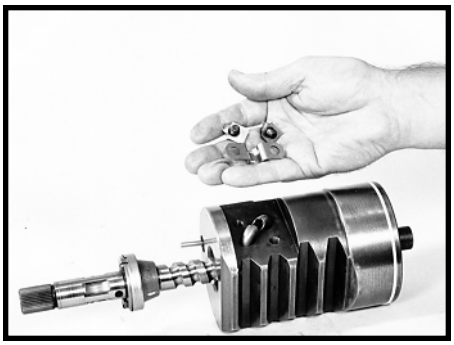

Figure 69

remove ball return guide cap, if equipped

34. For a rack piston with the ball return guide cap (48) instead of the clip, remove the two special screws (49) which will require either a 5/32 inch Allen wrench or a T-30 Torx wrench. SEE FIGURE 70. Remove the ball return guide cap and the ball return cap seal (47). SEE FIGURE 71. Discard screws and cap seal.

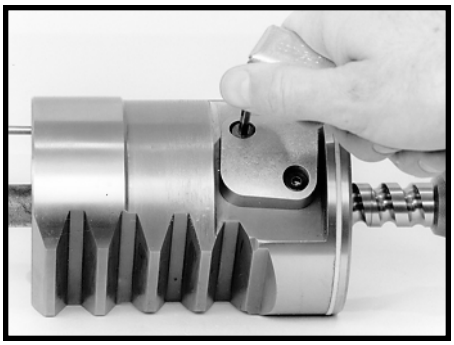

Figure 70

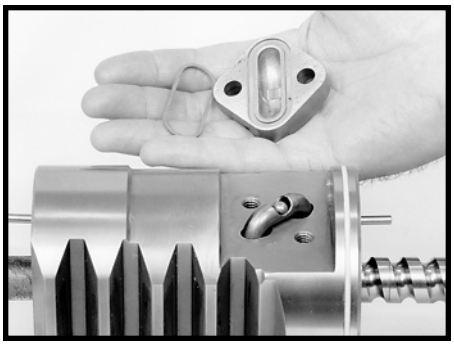

Figure 71

remove guides and balls

35. Remove the halves of the ball return guide (43) SEE FIGURE 72. Next, remove the 27 steel balls (42) from the rack piston (31) by rotating the worm shaft/input shaft (17) until the balls fall out. SEE FIGURE 73.

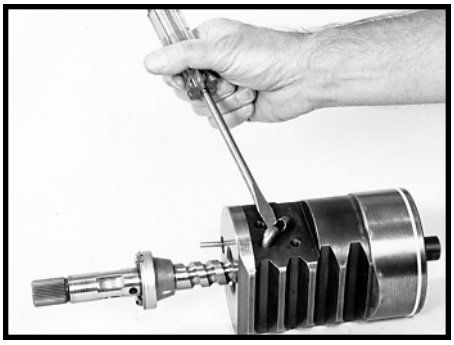

Figure 72

NOTE

NOTE: The ball return guide is closely fitted with the rack piston, and you may have to remove the halves by carefully inserting a screwdriver between the rack and the guide. See composite picture of both rack piston assembly types in FIGURE 74.

CAUTION

CAUTION: The 27 steel balls are a matched set. Take care not to lose any of them. If you lose any of the balls, you must replace them with a complete, new set.

WARNING

WARNING: INCORRECT MATCHING OF BALLS, WORMSCREW AND RACK PISTON CAN RESULT IN LOSS OF STEERING, WHICH COULD RESULT IN AN ACCIDENT.

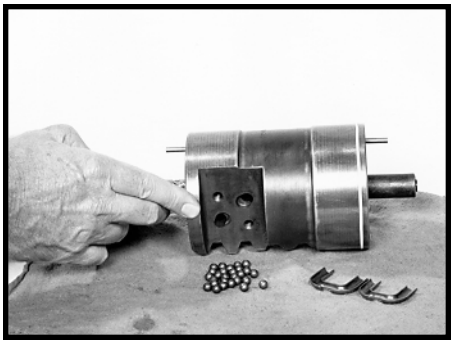

Figure 73

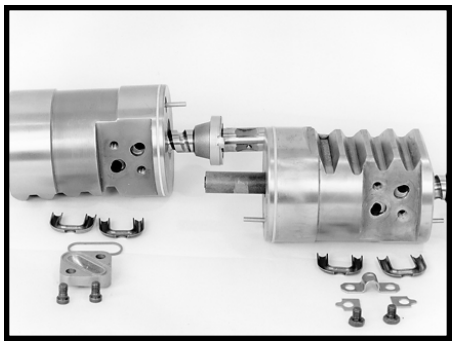

Figure 74

remove worm shaft/input shaft

36. Remove the worm shaft/input shaft (17) from the rack piston (31). SEE FIGURE 75.

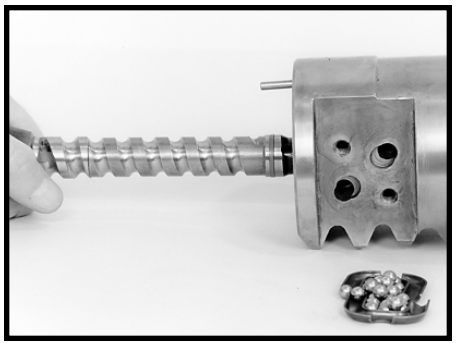

Figure 75

remove seal ring and O-ring

37. Remove and discard the Teflon rack piston seal ring (29) and backup O-ring (30). SEE FIGURE 76.

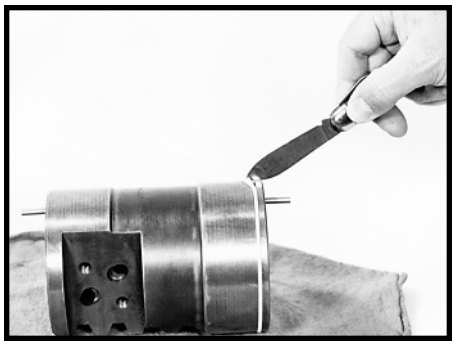

Figure 76

remove worm shaft seal ring and O-ring

38. Remove and discard the Teflon worm shaft seal ring (19) and O-ring (18). SEE FIGURE 77.

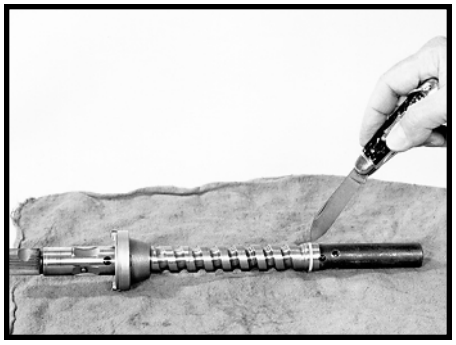

Figure 77

remove bleed screw

39. Your gear may be equipped with either a manual bleed screw (20A) or an automatic air bleed assembly (20B-E). If your gear has the manual bleed screw, remove it from the gear housing (20). A 5/16 inch socket required. SEE FIGURE 78. If your gear has the automatic air bleed assembly, it is usually not required that you service it. if it is necessary, however, remove the automatic bleed screw (20B) from the housing with a 1/2 inch socket or E-10 Torx socket. Then, tilt the housing upside down so that the special pin (20C) and spring (20D) will fall out. SEE FIGURE 79.

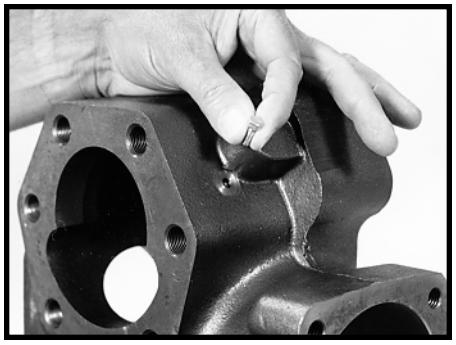

Figure 78

WARNING

WARNING: DURING STEP 40 YOU SHOULD WEAR EYE PROTECTION, AS THE SPRING LOADED POPPETS COULD EJECT, AND CAUSE EYE INJURY.

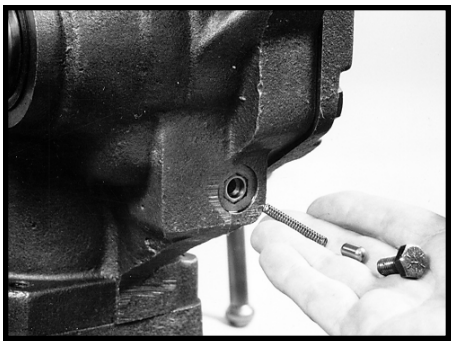

Figure 79

remove poppets, if equipped

40. If your gear is equipped with poppets, they will usually not require servicing. If it is necessary, however, position the rack piston (31) in a softjawed vice. Then, remove two poppet retaining rings (32), two poppet seats (33), two poppets (34), the nylon spacer rod (35), and the poppet spring (36). SEE FIGURES 80, 81, 82.

Figure 80

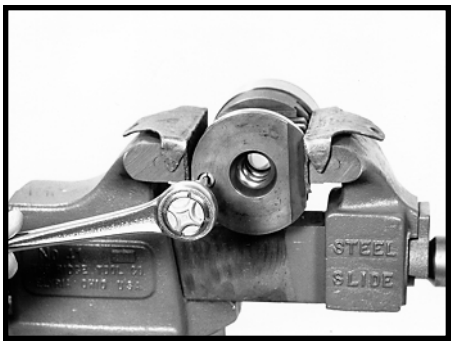

Figure 81

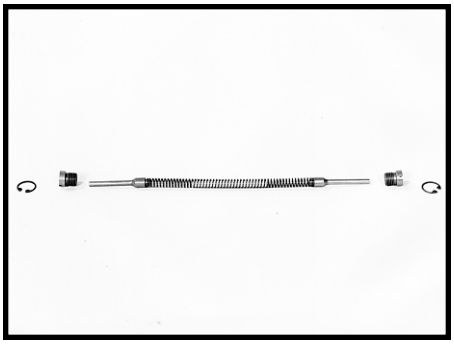

Figure 82

remove housing bearing, if necessary

41. The housing bearing assembly (21) or race should only be removed if you determine that only the bearing must be replaced after following inspection procedures 4, 5 and 6 on page 31. Remove the bearing in the following manner: Use bearing mandrel (special tool) J26738 or J37071 to apply pressure from the side cover opening and press the bearing out through the trunnion cover opening. SEE FIGURE 83. Maintain a good, square contact between the housing and press base to avoid damaging the housing bearing bore. Remove retaining ring (22) from bearing. Discard bearing.

CAUTION

CAUTION: If the bearing is cocked while you press it out, it will burnish the bore, causing it to become oversized. You will then have to replace the gear housing.

This completes disassembly of the HFB64 steering gear.

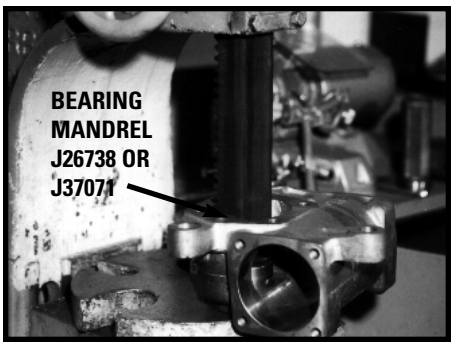

Figure 83

Inspection

- Check to make sure that all sealing surfaces and seal cavities are free from nicks and corrosion. If any part is nicked or corroded where sealing occurs, you must replace the part to insure proper sealing.

- Wash all parts in clean petroleum-based solvent. Blow them dry only.

WARNING

WARNING: SINCE THEY ARE FLAMMABLE, BE EXTREMELY CAREFUL WHEN USING ANY SOLVENT. EVEN A SMALL EXPLOSION OR FIRE COULD CAUSE INJURY OR DEATH.

WARNING

WARNING: WEAR EYE PROTECTION AND BE SURE TO COMPLY WITH OSHA OR OTHER MAXIMUM AIR PRESSURE REQUIREMENTS.

inspect rack piston teeth

1. Inspect the rack piston (31) teeth for cracks and wear. If you can detect a step by running your fingernail horizontally across the teeth surface, you must replace both the rack piston and sector shaft (50) and set of 27 balls (42). SEE FIGURE 84.

inspect rack piston internal grooves

2. Inspect the rack piston internal ball-track grooves for brinelling (dents) or spalling (flaking) SEE FIGURE 85. If either condition exists,you must replace the following parts: the rack piston (31), the worm shaft/input shaft (17), the valve sleeve (15), and set of 27 balls (42)

inspect worm shaft/input shaft

3. Inspect the worm shaft/input shaft assembly (17) ball track grooves for brinelling or spalling. SEE FIGURE 86. If either condition exists, you must replace all of the following parts: the worm shaft/input shaft assembly (17), the rack piston (31), the valve sleeve (15), the set of 27 balls (42). Visually inspect the upper shaft seal area near the input shaft serrations for nicks, and run your fingernail edge across the sealing surface to detect steps. SEE FIGURE 87. Visually inspect the sleeve contact area of the worm shaft/input shaft for discoloration from excess heat. If either of these conditions exist you must replace the worm shaft/input shaft assembly (17) and valve sleeve (15) as a matched set and the set of 27 balls (42).

NOTE

NOTE: The input shaft is pinned to the worm shaft by the torsion bar pin, and the assembly is flexible and may appear slightly bent at this joint. This slight bend is normal. SEE FIGURE 88.

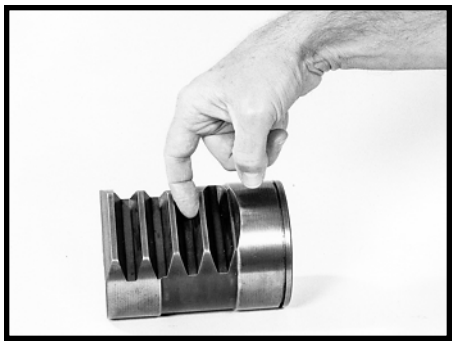

Figure 84

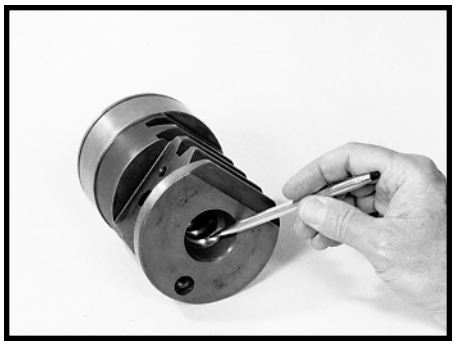

Figure 85

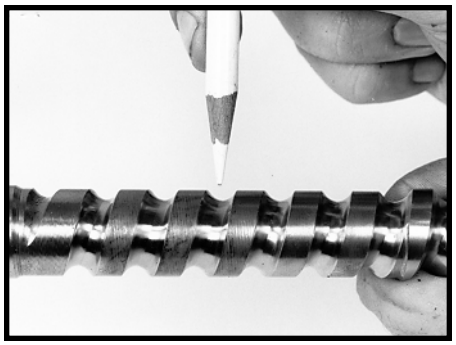

Figure 86

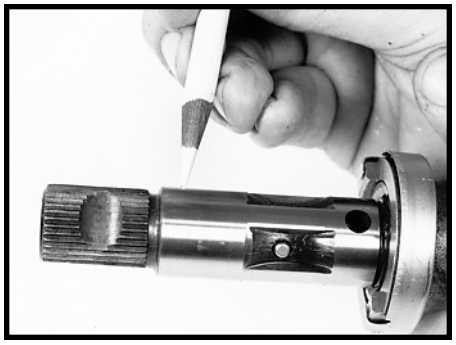

Figure 87

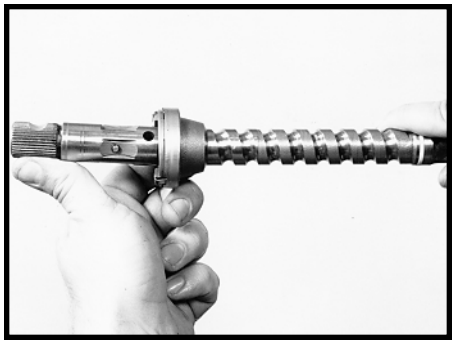

Figure 88

inspect housing cylinder bore

4. Inspect the housing cylinder bore. SEE FIGURE 89. You will probably notice normal scoring marks running lengthwise through the bore. Since this scoring is normal, you should not compare it to the scoring considered detrimental in the cylinder bores of an internal combustion engine. Replace the housing only if you've tested it for internal leakage (as described in the troubleshooting section on page 7) and you've determined that the scoring, and not damaged seals, is responsible for the excessive internal leakage, greater than 1.5 gpm (5.7 liters/min).

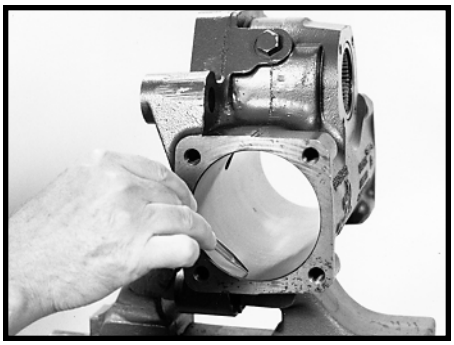

Figure 89

NOTE

NOTE: In running the internal leakage test after reassembly of the unit, make sure that internal leak age exceeding 1.0 gpm (3.8 liters/min.) can only be attributed to the housing and not to the improper assembly of the new seals in the worm shaft, rack piston, and valve assembly, before you replace the housing.

inspect housing faces

5. Inspect the housing (20) faces for nicks that would prevent proper sealing. Replace the gear housing if these nicks are present and cannot be easily removed with a fine-toothed flat file without changing the dimensional characteristics. SEE FIGURE 90.

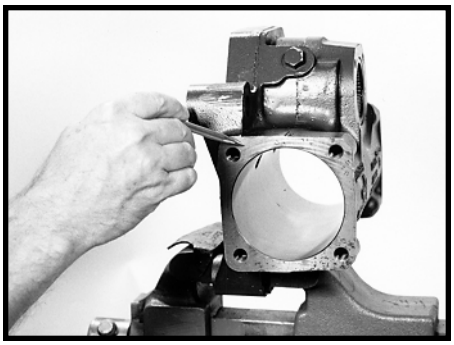

Figure 90

inspect housing and side cover bearings or bushing

6. Inspect the housing roller bearing (21) and the side cover bearing for brinelling or spalling. SEE FIGURES 91, 92. If either condition exists, replace the damaged housing bearing (21). For the housing bearing, follow disassembly step 41 and assembly step 2, pages 29 and 33. If the side cover roller bearing or "DU" bushing is damaged, replace side cover assembly.

   A side cover and bushing assembly must be discarded if sector shaft (50) to side cover bushing clearance exceeds .008 inch (0.20 mm). SEE FIGURE 92A.

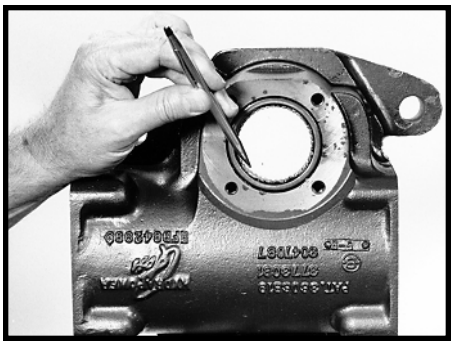

Figure 91

WARNING

WARNING: FOR BEARING TYPE WITH UNCAGED (LOOSE) ROLLS DO NOT MIX THE ROLLS FROM THE SIDE COVER BEARING WITH THE ROLLS FROM THE HOUSING BEARING. THE BEARING RACE AND ROLLERS ARE A MATCHED SET, INTERCHANGING THE ROLLS COULD RESULT IN PREMATURE BEARING OR SEAL FAILURE, WHICH COULD CAUSE A LOSS OF POWER STEERING.

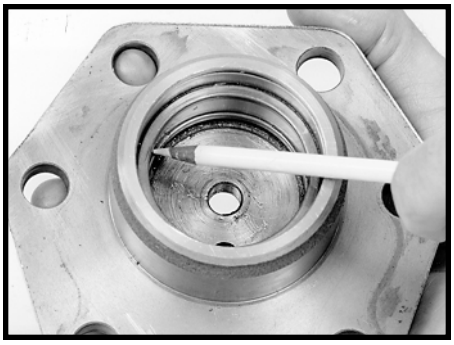

Figure 92

NOTE

NOTE: The latest service side cover assembly will include a caged roller bearing assembly, backup washer (56), two-piece seal (54/55), retaining ring (53) and vent plug (60).

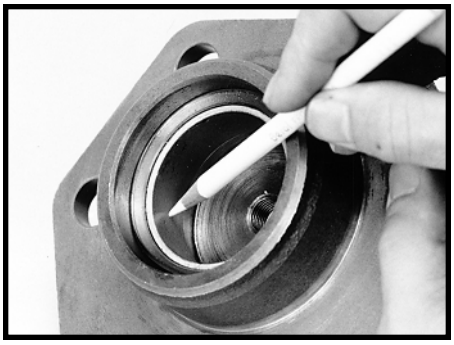

Figure 92A

inspect sector shaft assembly

7. Inspect the sector shaft (50) bearing and sealing areas and sector teeth contact surfaces for brinelling or spalling. SEE FIGURE 93. Run your fingernail edge across these areas to detect steps. Inspect also for cracks. Remove any masking tape from the shaft serrations and inspect for twisted or otherwise damaged serrations. If any of these conditions exist, replace the sector shaft.

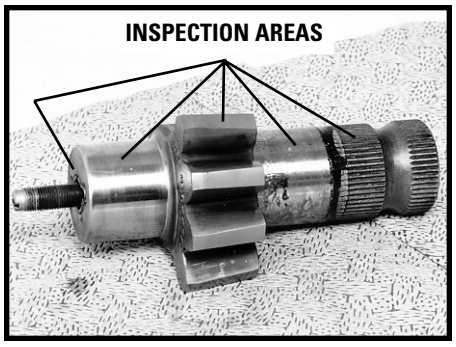

Figure 93

NOTE

NOTE: A service shaft assembly will have the adjusting screw (51) and retainer (52) assembled into it. The screw (51) and retainer (52) can be serviced separately if required.

inspect adjusting screw and retainer

8. Inspect the sector shaft assembly for damaged adjusting screw (51) threads. The staked retainer (52) must be locked in place, and have no cracks. The adjusting screw must rotate by hand with no perceptible end play (lash). Replace adjusting screw, if damaged. Replace the retainer, if damaged, or if the adjusting screw requires replacement or adjustment.

inspect thrust washers and bearing

9. Inspect the thrust bearing rollers (12) for any deterioration. Inspect the two thrust washers (11) for brinelling, spalling, or cracks. SEE FIGURE 94. Replace the part if you detect these conditions.

This completes inspection of the HFB64 steering gear.

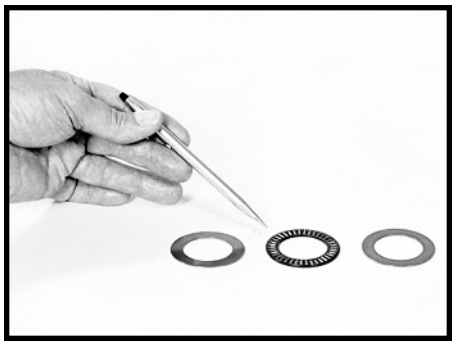
Figure 94

Assembly

Preparation

∫ Wash all parts in clean petroleum-based solvent. Blow them dry only.

WARNING **WARNING: SINCE THEY ARE FLAMMABLE, BE EXTREMELY CAREFUL WHEN USING ANY SOLVENT. EVEN A SMALL EXPLOSION OR FIRE COULD CAUSE INJURY OR DEATH.**

WARNING **WARNING: WEAR EYE PROTECTION AND BE SURE TO COMPLY WITH OSHA OR OTHER MAXIMUM AIR PRESSURE REQUIREMENTS.**

∫ Replace all seals, seal rings, and gaskets with new ones each time you disassemble the gear.

∫ Ross Gear does provide individual seals, seal rings, and gaskets, as well as complete and partial seal kits. SEE FIGURE 95. These parts should be available through most OEM parts distributors. (Contact your local dealer for availability.)

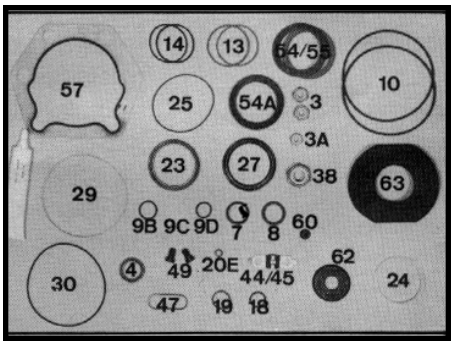

Figure 95

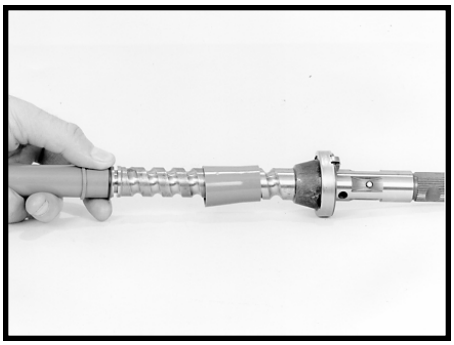

Figure 96

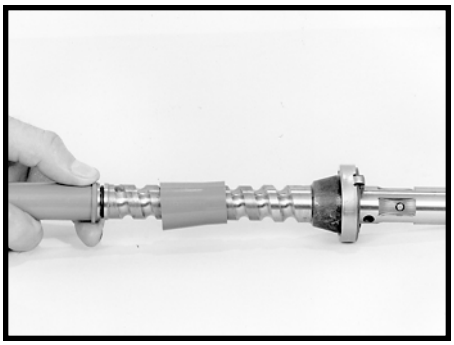

Figure 97

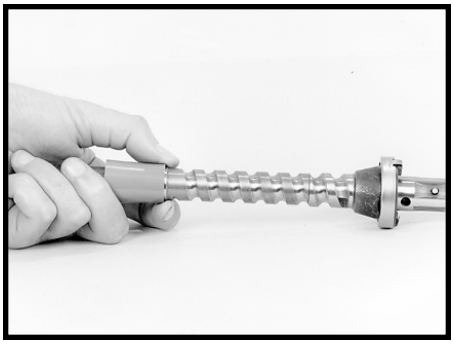

Figure 98

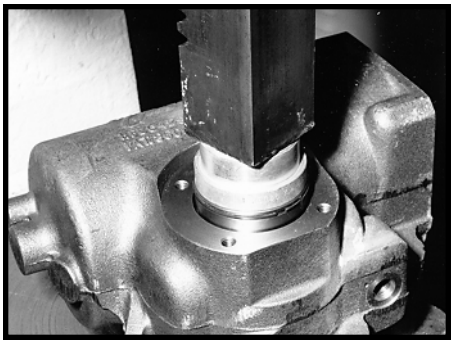

Figure 99

Assembly

assemble worm shaft O-ring & seal ring

1. Slide compression tool J26649, small diameter end first, onto the worm end of worm shaft/input shaft (17) until it is beyond the seal ring groove. Using seal installation tool J26550-01 assemble the new worm shaft O-ring (18), and then the new seal ring (19). SEE FIGURES 96, 97. Next, compress the seal ring by pulling the compression tool back over the seal ring. Allow the worm shaft/input shaft to set with compression tool in place for at least ten minutes. SEE FIGURE 98.

CAUTION **CAUTION: Allow for this 10 minutes to insure that the O-ring and seal ring are properly seated when you install the worm shaft into the rack piston. If you do not allow for this time, the seal may tear or be cut when you place the worm into the rack.**

install housing bearing and retaining ring

2. If you are installing a new housing bearing (21) or using the old housing and bearing assembly, apply a generous amount of clean grease to the bearing race to retain the bearing rolls. Then, place the rolls into the race, being sure you have the correct quantity of rolls for your particular bearing assembly. To install the new bearing assembly (21) into the housing, first install the retaining ring (22) into the groove on the bearing's outside diameter. Then press the bearing into the housing from the trunnion side using bearing mandrel (special tool) J26738 or J37071 against the lettered end of the bearing shell so that the retaining ring is away from the housing bore. SEE FIGURE 99. During this procedure be sure that the housing is square with press base and the bearing is not cocked.

NOTE

NOTE: If you are installing bearing BR-866-1 or a bearing with no part number, install 44 rolls. If you are installing bearings F83508, install 43 rolls.

CAUTION

CAUTION: The bearing rolls must be in place to insure proper installation of the bearing. If the rolls are improperly installed, the bearing race may collapse and fail. The flange may break, causing premature failure of the bearing. Again, do not mix the housing bearing rolls with the side cover bearing rolls. Be sure the bearing mandrel used is clean.

NOTE

NOTE: The bearing assembly (21) may be of caged (retained) roll type therefore not requiring reassembly of the rolls.

install rack piston seal and O-ring

3. Install the new rack piston backup O-ring (30) and then the new Teflon rack piston seal ring (29) SEE FIGURES 100, 101. Do not over stretch these rings as you install them. After you install them, coat them with a liberal amount of grease.

Figure 100

Figure 101

WARNING

WARNING: DURING STEP 4, YOU SHOULD WEAR EYE PROTECTION, AS THE SPRING LOADED POPPETS COULD EJECT, AND CAUSE EYE INJURY.

install poppet assembly, if removed

4. If the gear is equipped with poppets and the poppets were removed, then install into the rack piston (31) one poppet seat (33). SEE FIGURE 102. From the other end of the rack piston install one poppet (34), the spring (36), the nylon spacer rod (35), the other poppet (34), and the other poppet seat (33). Torque both poppet seats to 20-25 ft. lbs. (27-34 N m). Install both retaining rings (32). SEE FIGURES 103,104.

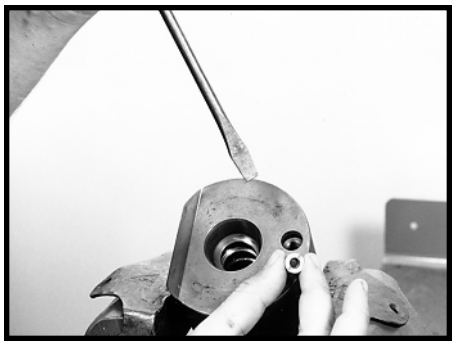

Figure 102

Figure 103

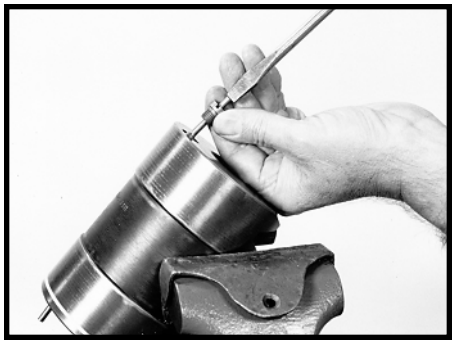

Figure 104

install worm shaft/input shaft into rack piston

5. When the 10 minute compression time has elapsed, remove the compression tool from the worm shaft/input shaft assembly (17). Grease the worm shaft seal ring (19) and the sealing surface inside the rack piston (31). Install the worm shaft/input shaft assembly into the rack piston end that will position the worm seal ring in the rack bore and position the worm ball track grooves to accept the set of balls through the rack piston ball guide holes. SEE FIGURE 105.

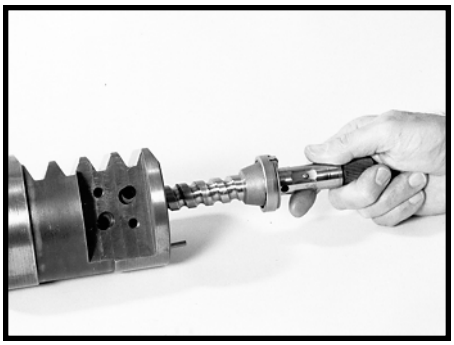

Figure 105

assemble ball return guide halves

6. Assemble the ball return guide halves (43) into the rack piston (31) Make sure they are correctly seated. SEE FIGURE 106.

WARNING

WARNING: DO NOT SEAT GUIDES WITH A HAMMER, DAMAGE TO GUIDES CAN RESULT IN SUBSEQUENT LOCKUP OR LOSS OF STEERING.

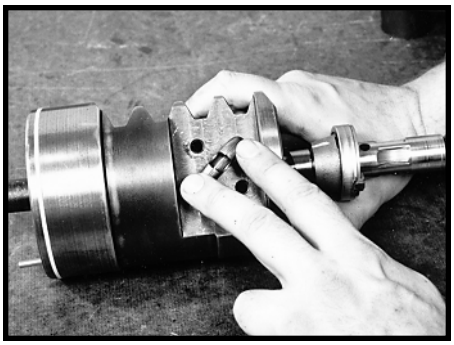

Figure 106

assemble balls

7. Assemble 27 steel balls (42) into the ball return guide through the hole provided in the top of the guide. As you drop the balls into the guide, rotate the worm shaft (17) to pull the balls down into the ball track grooves. SEE FIGURE 107.

WARNING

WARNING: MAKE SURE THE BALL RETURN GUIDE STAYS DOWN IN PLACE AS YOU DROP THE BALLS THROUGH THE HOLE. FAILURE TO HOLD THE GUIDE DOWN MAY RESULT IN A BALL BEING TRAPPED OUTSIDE THE CLOSED LOOP. A TRAPPED BALL CAN RESULT IN A STEERING LOCKUP, WHICH COULD CAUSE AN ACCIDENT.

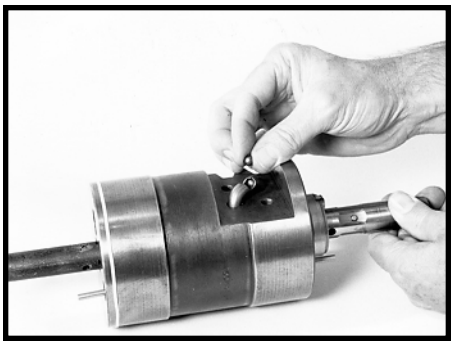

Figure 107

assemble ball return guide clip, if equipped

8. If your gear is equipped with the ball return guide clip (44), install it so that both bolt hole faces are in full contact with the rack piston surface. Install two new lock tabs (45) and the two hex head bolts (46). Torque the bolts to 14-22 ft. lbs. (19-30 N m). Finish by bending the locking tabs up against the bolt head flats. 1/2 inch socket required. SEE FIGURE 108.

NOTE

NOTE: The current ball return guide clip (44/45) will have integral lock tabs and be included in current service seal kits.

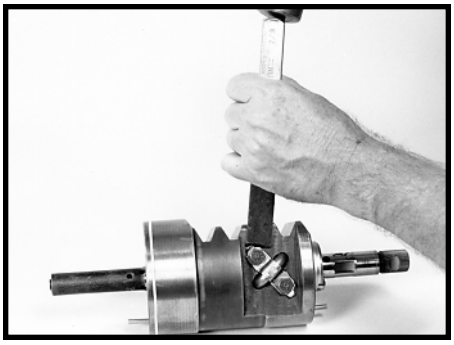

Figure 108

assemble ball return guide cap, if equipped

9. If your gear is equipped with the ball return guide cap (48), instead of the clip, grease the ball return guide cap seal (47) and place it in the seal groove of the cap. Assemble the cap so that the seal makes full contact with the rack piston surface. SEE FIGURE 109. Install two new Allen or Torx head bolts (49) and torque them to 14-22 ft. lbs. (19-30 N m). A 5/32 inch Allen socket or T-30 Torx socket required.

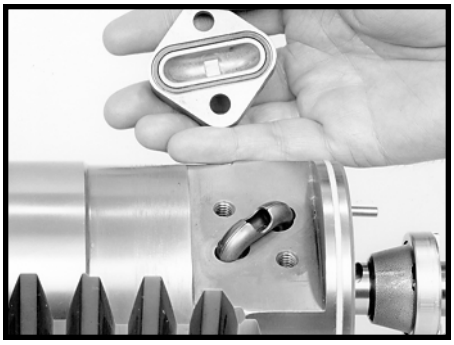

Figure 109

WARNING

WARNING: ROTATE THE WORM SHAFT FROM ONE END OF TRAVEL TO THE OTHER, TO MAKE CERTAIN THAT YOU HAVE INSTALLED THE BALLS PROPERLY. SEE FIGURE 110. IF YOU CANNOT ROTATE THE WORM SHAFT, YOU WILL HAVE TO REMOVE THE BALLS AND REASSEMBLE THEM. IF YOU INSTALL A GEAR ON A TRUCK WITH THE WORM SHAFT UNABLE TO ROTATE, THE GEAR WILL NOT FUNCTION CORRECTLY. DAMAGE MAY RESULT.

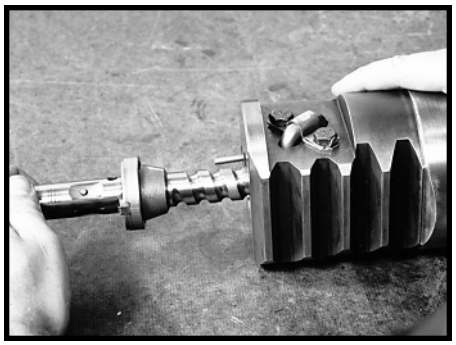

Figure 110

install rack piston and worm shaft/input shaft assembly into housing

10. Position the housing (20) securely in a vise as it was for the disassembly procedures. SEE FIGURE 38 page 20. Apply a generous amount of clean grease to the Teflon rack piston seal ring (29) and to the housing cylinder bore. Install the rack piston (31) and worm shaft/input shaft (17) as an assembly into the long end of the gear housing (20), if the housing rack piston bore is open on both ends, so that the Teflon rack piston seal ring goes in last. SEE FIGURE 111.

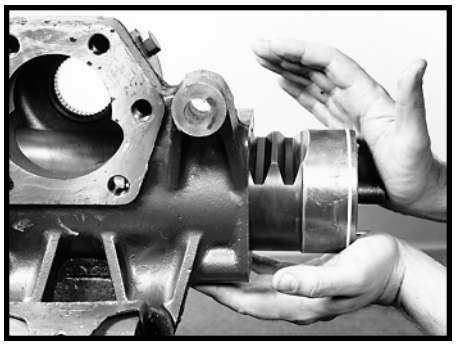

Figure 111

CAUTION

CAUTION: Be certain that the seal goes into the long end of the housing last if the housing bore is open on both ends. Otherwise, a large section of the seal will be cut, and the vehicle will have no power steering assist.

CAUTION

CAUTION: If the housing rack piston bore is open only on one end and the seal ring end of the rack piston must enter the housing first, the rack piston cannot be removed after it is assembled into the housing without destroying the rack piston seal ring.

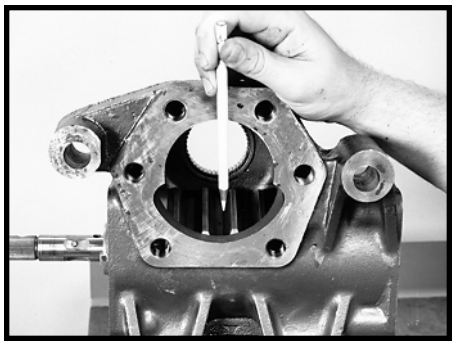

Figure 112

NOTE

NOTE: To ease the later assembly of the sector shaft, rotate the rack piston and worm shaft assembly in the housing so that the rack teeth are exposed in the sector shaft cavity of the housing. SEE FIGURE 112.

assemble sealing nuts and adjusting screws

11. If they were disassembled, assemble the new worm shaft adjusting screw sealing nut (38) onto the nonslotted end of the worm shaft preload adjusting screw (39) so that the seal on sealing nut will face the end cover (37) or closed end of housing. SEE FIGURE 113. Assemble a new sealing nut (3) onto poppet adjusting screws (2) and (40) in the same manner.

Figure 113

assemble poppet screw assembly into end cover

12. Assemble poppet adjusting screw (40) and nut (3) assembly into end cover (37) or closed end of housing (20) a few turns. Final adjustments will be made later.

WARNING

WARNING: IF SCREWS (2) AND (40) ARE UNEQUAL IN LENGTH, YOU MUST INSTALL THE SHORTER SCREW INTO END COVER OR CLOSED END OF HOUSING. OTHERWISE, THE POPPET ASSEMBLY MAY BREAK AND LOCK UP THE STEERING GEAR, POSSIBLY RESULTING IN AN ACCIDENT.

NOTE

NOTE: More recent models of the HFB64 have a 5/16 24-2A poppet adjusting screw (2A) in the valve housing (9). This screw has an enlarged end. If your gear is equipped with this screw you must install the sealing nut (3A) onto the end of the screw after you assemble the screw into the valve housing. SEE FIGURE 121.

Figure 114

install adjusting screw

13. Install the worm shaft preload adjusting screw (39) and nut (38) into the end cover (37) or closed end of the gear housing (20) a few turns. SEE FIGURE 114. Final adjustments for worm and poppet adjusting screws will be made later.

install end cover seal ring

14. If your gear is equipped with the removable end cover (37), apply clean grease to the seal ring groove in the end cover. Install the new end cover seal ring (10) into the groove. SEE FIGURE 115.

NOTE

NOTE: When installed, the seal ring will extend slightly above the machined surface of the end cover.

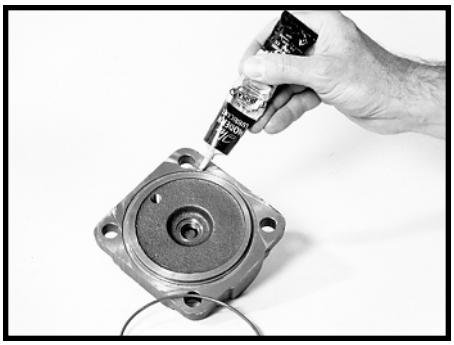

Figure 115

CAUTION

CAUTION: When performing step 15, make sure that the rack piston teeth are fully visible in the sector shaft cavity of the gear housing (20). This will insure proper location of the poppets and insure also that the poppet adjusting screw will contact the poppet.

install end cover

15. If your gear has the removable end cover (37), position it so that the poppet adjusting screw (40) is aligned with the end of the poppet (34). SEE FIGURE 116. Push the end cover in until it contacts the gear housing.

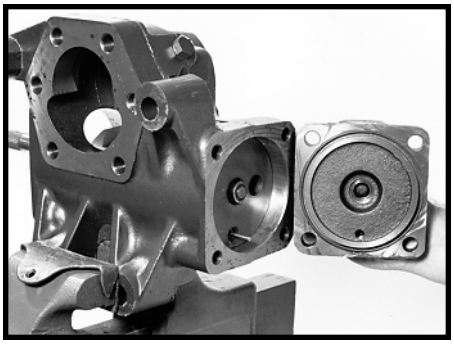

Figure 116

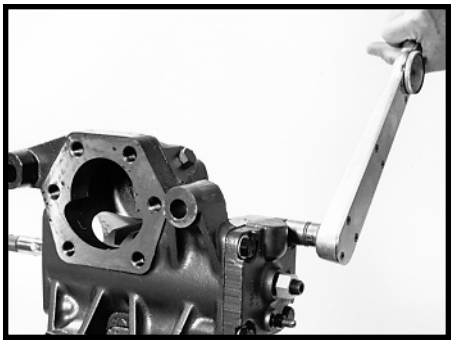

Figure 117

install end cover bolts

16. Install the four end cover bolts (41) 1.38 inch (35.1 mm) long and washers (41A), and torque the bolts to 105-115 ft. lbs. (142-156 N m) if dry or 75-85 ft. lbs. (102-115 N m) if lubricated. SEE FIGURE 117. 13/16 inch hex or E-16 Torx socket required.

install valve sleeve rings and seals

17. Grease the two new backup O-rings (14) and the two new Teflon seal rings (13). Using seal installation tool J26647, assemble the backup O-rings, and then the seal rings onto the valve sleeve (15). SEE FIGURES 118,119.

NOTE

NOTE: Assemble each O-ring and seal ring from the end closest to its groove.

Figure 118

Figure 119

compress rings

18. Use the compression tool J26648 to compress the Teflon seal rings. Leave this compression tool on for 10 minutes. SEE FIGURE 120.

CAUTION

CAUTION: Allow for this at least ten minutes, to ensure that the seals are properly seated. Otherwise, the valve sleeve will be difficult to assemble into the valve housing, and the seal maybe cut during installation.

Figure 120

assemble poppet screw

19. If removed, assemble the poppet valve adjusting (2) and nut (3) assembly into the valve housing (9) a few turns.

NOTE

NOTE: If your gear is equipped with the 5/16 24 UNF 2A poppet adjusting screw (2A), assemble the screw from the inside of the valve housing. The screw should be run out until just before the enlarged end of the screw bottoms on the counterbore of the valve housing. Then assemble sealing nut (3A) with the seal facing the housing. SEE FIGURES 121, 122.

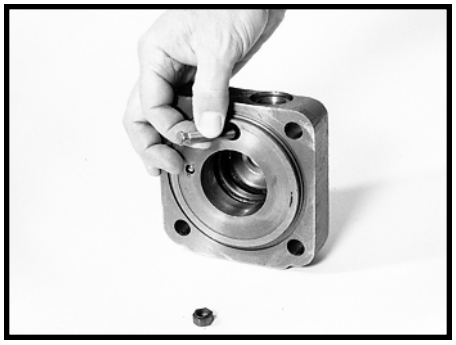

Figure 121

CAUTION

CAUTION: Take special care when you run this screw out. If you apply excessive torque (above 35 in. lbs. or 4.0 N m) to the screw after the enlarged end bottoms in the counterbore, you could break the internal Allen hex or driver slot. You will then have to replace the screw, and if you cannot remove it from the valve housing, you will have to replace the entire valve housing assembly.

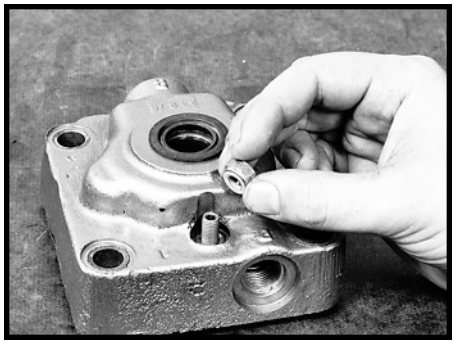

Figure 122

install valve housing seal ring

20. Apply clean grease to the seal ring groove in valve housing (9) and install a new seal ring (10) into the groove. SEE FIGURE 123. If the unit is equipped with an automatic bleed screw, apply clean grease to a new passage way seal (20E) and install it in the valve housing.

NOTE

NOTE: When installed, the valve housing seal ring should extend slightly above the machined surface of the valve housing.

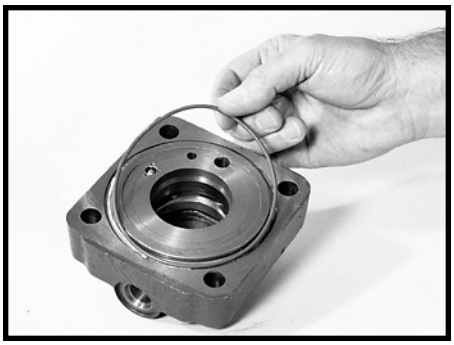

Figure 123

install first thrust washer

21. Apply a generous amount of clean grease to one thrust washer (11). Place the valve housing, exterior side down, on a flat surface and place the thrust washer into the valve housing (9), making sure to center the washer. SEE FIGURE 124.

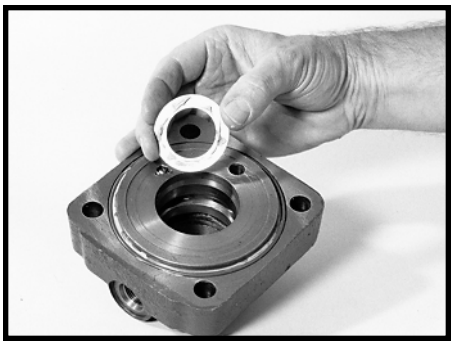

Figure 124

install thrust bearing

22. Apply a generous amount of clean grease to the thrust bearing (12). Install the bearing into the valve housing (9) and onto the first thrust washer, making sure to center the bearing on the washer. SEE FIGURE 125.

WARNING

WARNING: THE THRUST WASHER AND THRUST BEARING MUST BE FLAT AND CENTERED IN THE COUNTERBORE SURFACE OF THE VALVE HOUSING. OTHERWISE, THE THRUST WASHER COULD BREAK WHEN YOU PLACE THE VALVE HOUSING ONTO THE GEAR HOUSING. A BROKEN THRUST WASHER COULD CAUSE UNCONTROLLABLE STEERING, POSSIBLY RESULTING IN AN ACCIDENT.

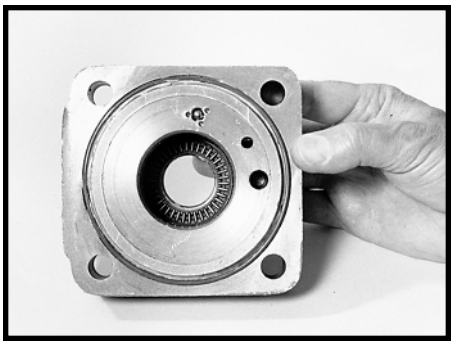

Figure 125

Figure 126

install second thrust washer

23. When the compression time has elapsed, remove the compression tool from the valve sleeve (15). Apply more grease to the valve sleeve seals (13 and 14), and grease the thrust washer face on the end of the valve sleeve without the drive slots. SEE FIGURE 127. Place the second thrust washer (11) onto this face.

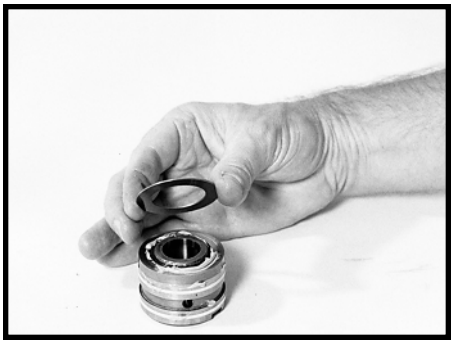

Figure 127

WARNING

WARNING: THIS THRUST WASHER MUST BE SECURELY IN PLACE ON THE VALVE SLEEVE. IF IT IS NOT, IT CAN BREAK AND CAUSE UNCONTROLLABLE STEERING, POSSIBLY RESULTING IN AN ACCIDENT.

Figure 128

assemble valve sleeve into valve housing

24. Locate the timing mark on the valve sleeve (15), a faint, punched mark on the chamfered edge of the sleeve or an indented mark on the front face of the sleeve. Make a corresponding mark on the front face with a felt marker if the edge is marked. SEE FIGURE 128. Assemble the valve sleeve (15), with the second thrust washer attached, into the valve housing (9), thrust-washer end first. When the valve sleeve is properly in place, the valve sleeve face should measure approximately .40 in. (10.2 mm) below the face of the valve housing. SEE FIGURE 129.

WARNING

WARNING: DO NOT FORCE THE VALVE SLEEVE DOWN INTO THE VALVE HOUSING. MAKE SURE THE VALVE SLEEVE SEAL RINGS ARE COMPRESSED. MISASSEMBLY OR INCORRECT MEASUREMENT MAY CAUSE THE THRUST WASHERS OR THRUST BEARING TO BREAK DURING GEAR OPERATION. THIS WILL RESULT IN UNCONTROLLABLE STEERING.

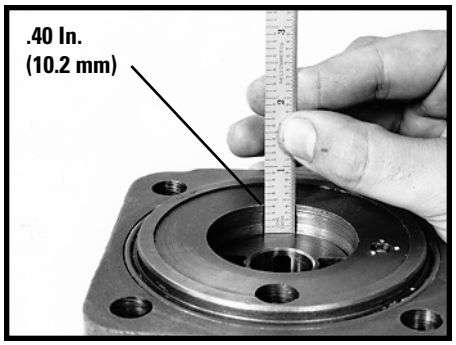

Figure 129

position rack piston and rotate worm shaft/input shaft assembly

25. Position the rack piston (31) so that it is flush with the valve housing end of the gear housing. Rotate the worm shaft (17) until it extends out of the rack piston as far as it will go. SEE FIGURE 130.

WARNING

WARNING: THE WORM SHAFT AND VALVE SLEEVE ASSEMBLY IS ASSEMBLED AND SOLD AS A MATCHED SET. USE ONLY MATCHED SETS FOR REPLACEMENT. NEVER MATE AN OLD VALVE SLEEVE WITH A NEW WORM SHAFT, OR AN OLD WORM SHAFT WITH A NEW VALVE SLEEVE. TO DO EITHER MAY RESULT IN DAMAGE TO THE GEAR OR INJURY TO THE DRIVER DURING OPERATION.

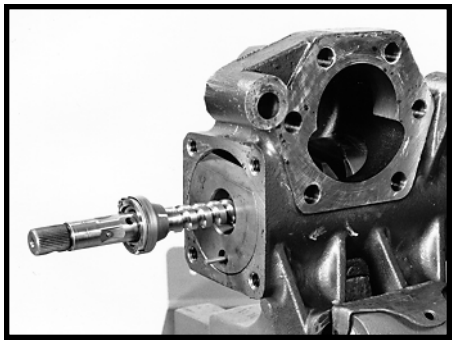

Figure 130

install valve assembly onto worm shaft/input shaft assembly

26. Locate the scribed timing marks on the worm shaft/input shaft assembly (17) and valve sleeve (15). SEE FIGURE 131. Next, grasp the valve housing (9) and valve sleeve as an assembly, with your thumbs on the valve housing and your fingers applying pressure on the valve sleeve to keep it in the valve housing. SEE FIGURE 132. Align the previously located timing marks and place the valve housing and valve sleeve as an assembly onto the input shaft end of the worm shaft/input shaft until the drive lugs on assembly (17) are fully engaged in valve sleeve lug slots. SEE FIGURE 133.

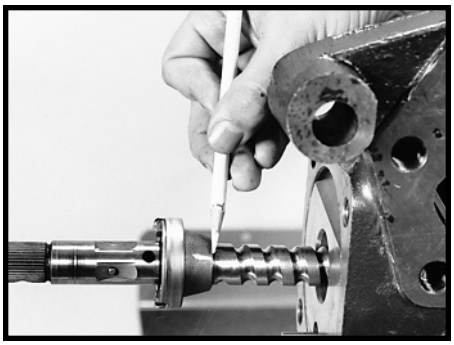

Figure 131

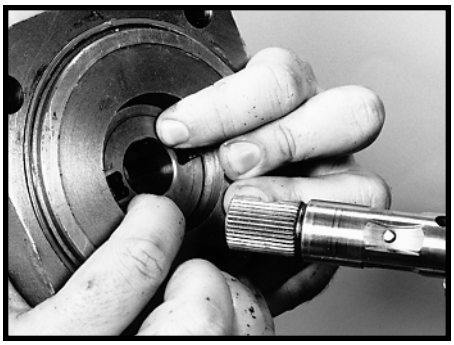

Figure 132

NOTE

NOTE: Valve sleeves are identified and matched to a right or left hand lead of the worm screw. If the screw has a right hand thread (that is, goes into the rack piston when turned clockwise), the valve sleeve will have the letter "R" stamped between the seal lands. For a left hand worm lead (which will come out of the rack piston when turned clockwise), the mating valve sleeve has no identifying letter or has the letter "L" stamped between the seal lands.

WARNING

WARNING: IF YOU PLACE AN INCORRECT VALVE SLEEVE ON A WORM AND ASSEMBLE THIS INTO THE GEAR, THE GEAR WILL NOT FUNCTION PROPERLY. INSTEAD, THE MECHANISM WILL JERK THE STEERING WHEEL WITH SUCH FORCE, THAT IT COULD INJURE THE DRIVER.

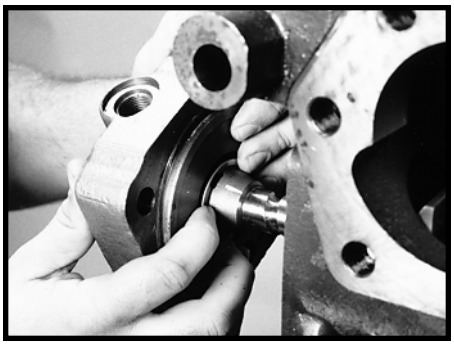

Figure 133

finish valve housing installation

27. Maintain pressure on the valve end of the valve housing to insure continued engagement of the drive lugs and thrust bearing package. While maintaining this pressure, rotate the valve housing to align the poppet adjusting screw (if equipped) with the poppet in the rack piston (31). SEE FIGURE 134. The automatic bleed passageway must also be aligned if so equipped. While maintaining pressure, rotate the input shaft to bring the valve housing into contact with the gear housing face.

NOTE

NOTE: If a line was scribed across the valve housing and gear housing before disassembly, as recommended, use the line for correct valve housing positioning.

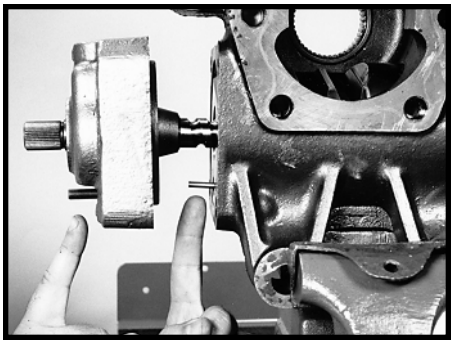

Figure 134

install valve housing bolts

28. Install the four valve housing bolts (1), 2.13 inch (54.0 mm) long, into the valve housing (9) Torque them to 105-115 ft. lbs. (142-156 N m) if dry or 75-85 ft. lbs. (102-115 N m) if lubricated. SEE FIGURE 135.

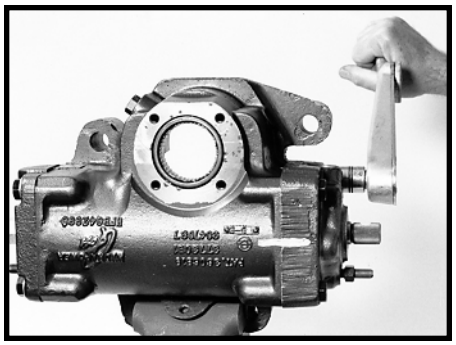

Figure 135

install relief valve

29. If your gear is equipped with a relief valve (9A), then assemble the new O-ring (9B), the new Teflon seal ring (9C), and the new O-ring (9D) onto the relief valve. SEE FIGURE 136. Install the relief valve into the valve housing (9) and torque it to 25-35 ft. lbs. (34-48 N m). One inch socket required

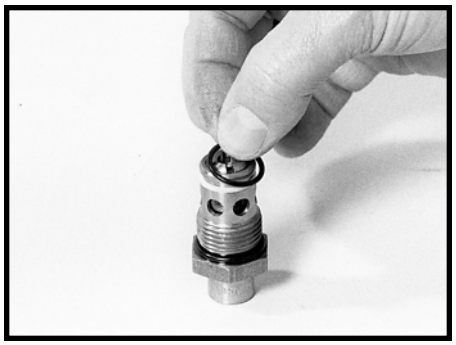

Figure 136

assemble adjusting screw and retainer

30. If the adjusting screw (51) has been removed from the sector shaft (50), clamp the sector shaft into a soft-faced vise by gripping the serrated end. Coat the expanded end of the new adjusting screw with a suitable grade of wheel bearing grease and insert into recess in end of sector shaft. Thread a new sector shaft screw retainer (52) into the sector shaft and adjust to permit free rotation of sector shaft adjusting screw by hand without perceptible end play (.000 to .002 in. [.05 mm] loose). Stake the new retainer into the two slots provided using a suitable punch and again check freedom of adjusting screw movement and end play. SEE FIGURE 137.

WARNING

WARNING: USE CARE IN SECURELY STAKING THE RETAINER (52) INTO THE SECTOR SHAFT SLOTS. A RETAINER THAT IS BROKEN OR CRACKED DURING THE STAKING PROCEDURE MUST BE REPLACED AS IT COULD RESULT IN THE SECTOR SHAFT NOT BEING RETAINED AND THE LOSS OF MANUAL AND POWER STEERING CONTROL.

grease side cover bearing or oil "DU" bushing

31. Apply a generous amount of clean wheel bearing grease (do not substitute another type of grease) to the bearing race inside the side cover (58), and to the rolls if they are caged (retained) rolls. Apply only oil for assembly purposes if the side cover has a "DU" bushing instead of a roller bearing assembly.

CAUTION

CAUTION: Use only wheel bearing grease on the roller bearing assembly. This bearing is sealed and will receive no lubrication from the hydraulic fluid in the gear. Without wheel bearing grease, the bearing could wear prematurely. The "DU" bushing material does not require lubrication.

Figure 137

assemble side cover bearing rolls

32. If the side cover (58) has loose bearing rolls, assemble the bearing rolls into the side cover bearing race. An unmarked bearing or bearing BR-866-1 requires 44 rolls. Bearing F83508 requires 43 rolls. SEE FIGURE 138.

CAUTION

CAUTION: Apply more wheel bearing grease to these rolls to retain them in the bearing race.

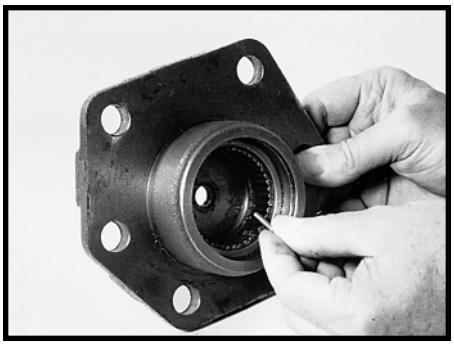

Figure 138

assemble side cover seal pack

33. If side cover (58) is being reassembled, assemble the steel back up washer (56) into side cover. Assemble a new two piece seal (54/55) that has the integral Teflon washer, into the side cover, such that the words "oil side" are visible after the seal is assembled. SEE FIGURE 139.

WARNING

WARNING: THE WORDS "OIL SIDE" MUST BE VISIBLE ONCE THE SEAL IS IN PLACE. OTHERWISE, THE SEAL WILL NOT FUNCTION, WHICH COULD RESULT IN A LOSS OF POWER STEERING ASSIST.

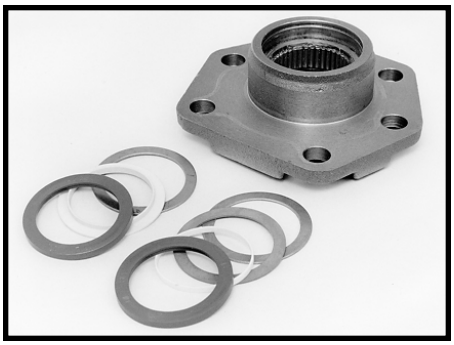

Figure 139

If side cover (58A) that requires only one piece seal (54A) is being assembled, lightly oil and assemble a new seal on bearing and seal installation tool J37071 so that the side with the garter spring is against the shoulder of the tool. Pilot the tool into the side cover bushing and press the seal into the side cover with a force of 100-800 LB. (45.4-362.8 KG) until it is seated against the bottom of the counterbore. SEE FIGURE 140.

CAUTION

CAUTION: Be sure that a separate Teflon washer (55) is not used with a two-piece seal (54/55) that has the Teflon washer integral to it.

Figure 140

assemble retaining ring

34. Assemble the side cover retaining ring (53) into the ring groove of the side cover (58) if required. SEE FIGURE 141.

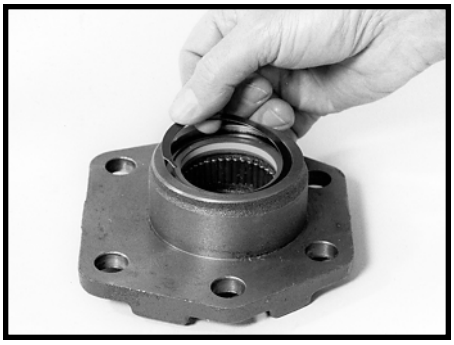

Figure 141

install sector shaft into side cover

35. Apply a generous amount of clean grease to the short bearing area of the sector shaft (50) only if the shaft cover has a roller bearing or lightly oil short bearing area if shaft cover has a "DU" bushing. Insert the sector shaft into the side cover (58) or (58A). Screw in the sector shaft adjusting screw (51) counterclockwise into the side cover until the screw reaches solid height. Then, rotate the adjusting screw clockwise one turn, so that the side cover will rotate freely on the sector shaft. SEE FIGURE 142.

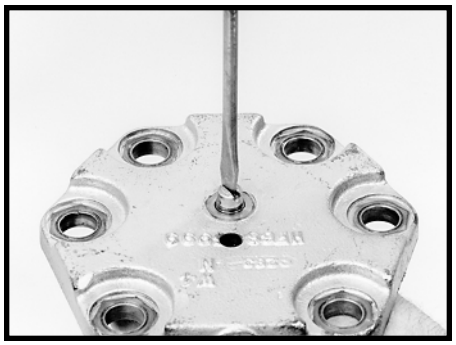

Figure 142

CAUTION

CAUTION: Be sure that one or more bearing rolls do not become dislodged during assembly of sector shaft into side cover.

install jam nut

36. Install the sector shaft adjusting screw jam nut (59) onto the sector shaft adjusting screw(51) a few threads. Final adjustment will be made later. SEE FIGURE 143.

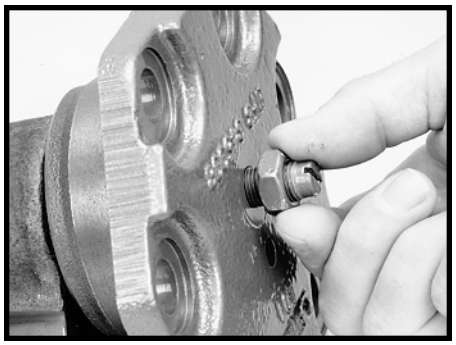

Figure 143

assemble vent plug

37. Press the new vent plug (60) into the hole provided in the side cover (58) until the plug is flush. SEE FIGURE 144.

WARNING

WARNING: DO NOT WELD OR OTHERWISE PLUG THIS HOLE IN ANY PERMANENT MANNER. THIS IS A SAFETY VENT WHICH FUNCTIONS ONLY IF THE SIDE COVER SEAL FAILS. IF THE SEAL FAILS AND THE PLUG CANNOT VENT, THE STEERING GEAR MAY LOCKUP OR OTHERWISE MALFUNCTION.

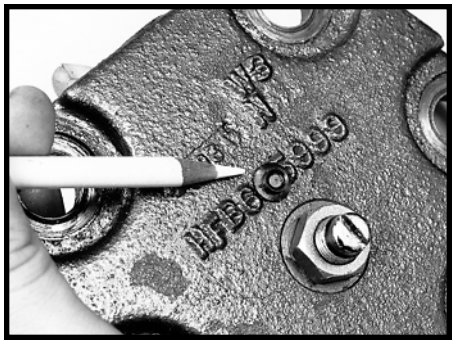

Figure 144

install side cover gasket

38. Apply clean grease to the new side cover gasket (57), and assemble it onto the side cover (58). Apply enough grease to hold the gasket in place. SEE FIGURE 145.

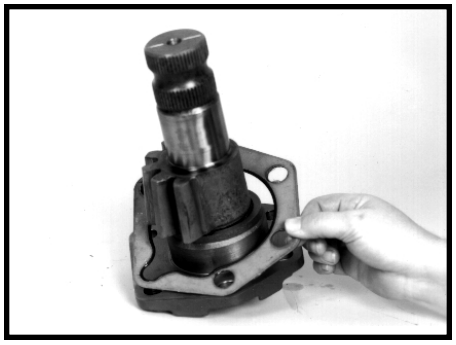

Figure 145

center rack piston

39. There are four teeth on the rack piston (31). SEE FIGURE 146. Position the rack piston so that the tooth space identified by the pencil, it is the space between the second and third teeth, is in the center of the sector shaft opening. SEE FIGURE 147. This will center the rack piston in the opening.

WARNING

WARNING: IF THE RACK PISTON IS NOT CENTERED WHEN SECTOR SHAFT IS INSTALLED, GEAR TRAVEL WILL BE SEVERELY LIMITED IN ONE DIRECTION. THIS COULD RESULT IN AN ACCIDENT.

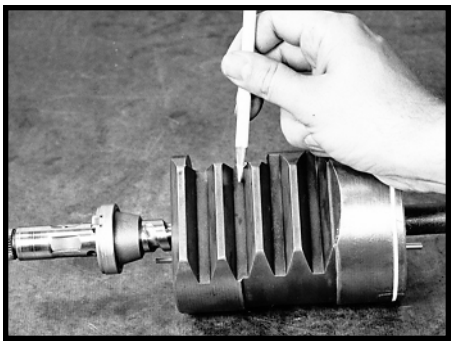

Figure 146

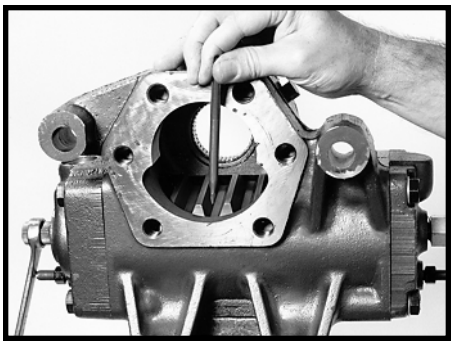

Figure 147

make initial worm preload adjustment

40. With the rack piston (31) in its center position, torque the worm shaft/input shaft adjusting screw (39) using a 5/16 inch Allen wrench socket into solid height (15 to 20 ft. lbs. [20.3 to 27.1 N m]). Then loosen the adjusting screw 1/4 to 1/2 turn and note torque required to rotate worm shaft/input shaft (17) through 90¡ each side of center, using an 11/16 inch or 3/4 inch 12 point socket and an appropriate torque wrench. SEE FIGURE 148. Loosen adjusting screw if noted input shaft torque exceeds 15 in. lbs. (1.7 N m). Return rack piston to center position.

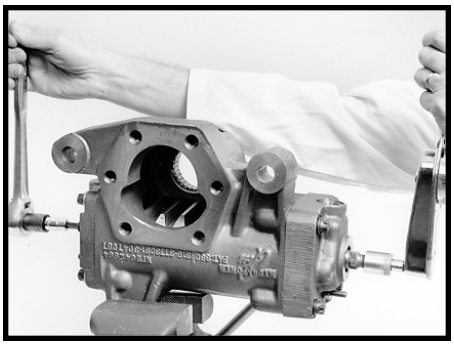

Figure 148

install sector shaft and side cover into housing

41. Clean off any old tape on the sector shaft (50) serrations. Retape the serrations and bolt groove with one layer of masking tape. Install the sector shaft and side cover (58) into the gear housing (20) as an assembly. Make sure that the center tooth of the sector shaft engages the center space (between the second and third teeth) of the rack piston. SEE FIGURE 149.

WARNING

WARNING: AS YOU PLACE THE SECTOR SHAFT THROUGH THE HOUSING BEARING (21), DO NOT KNOCK ANY OF THE BEARING ROLLS OUT OF THE BEARING RACE. DO NOT PINCH THE SIDE COVER GASKET (57). IF YOU DO EITHER, THE BEARING OR SEAL MAY PREMATURELY FAIL, AND THIS COULD RESULT IN A LOSS OF POWER STEERING ASSIST.

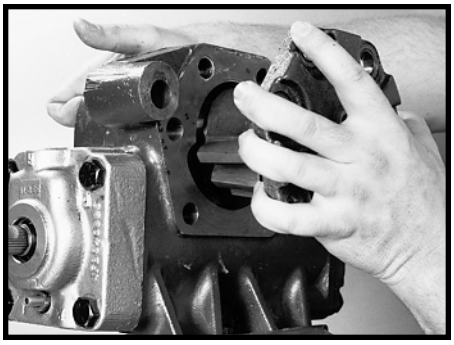

Figure 149

install side cover bolts

42. Install the six special side cover bolts (61) into the side cover and torque them to 220-240 ft. lbs. (298-325 N m) if dry or 160-180 ft. lbs. (217-244 N m) if lubricated. 15/16 inch socket required.

install trunnion cover washer

43. Place the trunnion cover (26) exterior face down on a bench and install the **new** Teflon backup washer (24). SEE FIGURE 150.

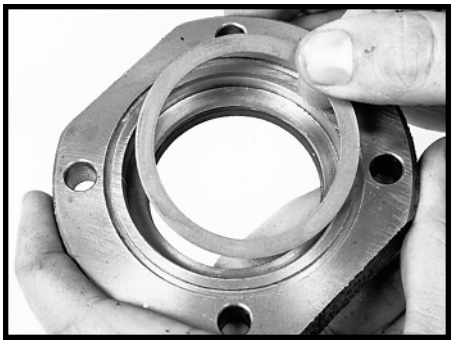

Figure 150

install seal

44. Next, install the **new** two-piece sector shaft seal (23) so that the words "oil side" are visible after the seal is in place. SEE FIGURE 151.

WARNING

WARNING: THE WORDS "OIL SIDE" MUST BE VISIBLE ON THE SEAL AFTER IT IS IN PLACE. IF NOT, THE SEAL WILL NOT FUNCTION, AND A LOSS OF POWER STEERING ASSIST MAY OCCUR.

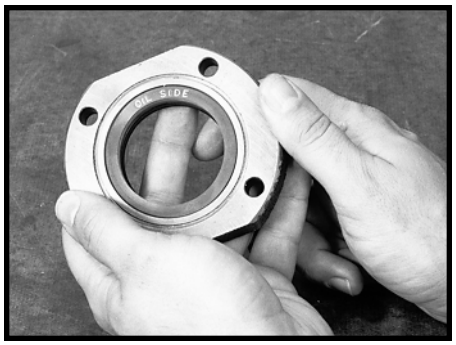

Figure 151

install seal ring

45. Grease the **new** trunnion cover seal ring (25) and install it into the trunnion cover (26) seal ring groove.

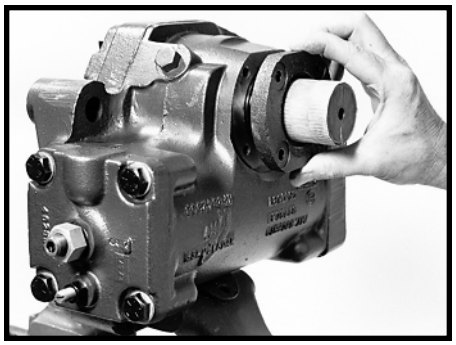
Figure 152

install trunnion cover and bolts

46. Visually inspect the housing bearing (21) to make sure that all of the bearing rolls are properly in place. Then install the trunnion cover (26). SEE FIGURE 152. Install the four trunnion cover bolts (28) and torque them to 15-22 ft. lbs. (20-30 N m) if dry or 11-16 ft. lbs. (15-22 N m) lubricated. SEE FIGURE 153.

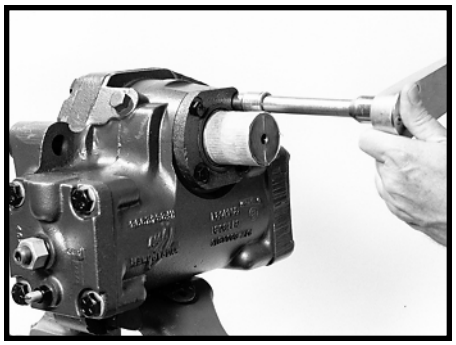
Figure 153

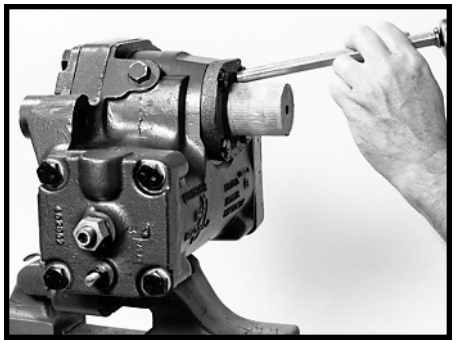
Figure 154

assemble dirt and water seal and protector boot

47. Pack the cavity around the seal area of sector shaft (50) with clean high temperature industrial grease per Ross specification 045231, Mobil Temp 1 or 2 or equivalent. Assemble a **new** dirt and water seal (27) using a suitable blunt end drift. SEE FIGURE 154. Apply a generous amount of the same grease inside of the inner ring of protector boot (63) Assemble protector boot (63) over sector shaft (50) and trunnion cover (26), locating the grease fitting hole toward the input shaft end of gear assembly. Assemble grease fitting (64) into its hole in the protector boot if required. SEE FIGURE 155.

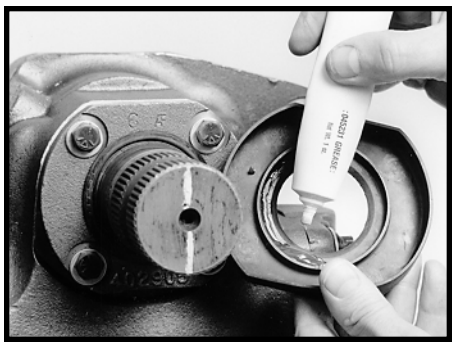
Figure 155

install input shaft seal pack

48. Apply clean grease to the input shaft seal assembly (7 and 8) and to the input shaft. Install the new two-piece input shaft seal (7 and 8), flat side out, and then the steel backup washer (6), using seal driving tool J26653. Install the retaining ring (5) SEE FIGURES 156, 157.

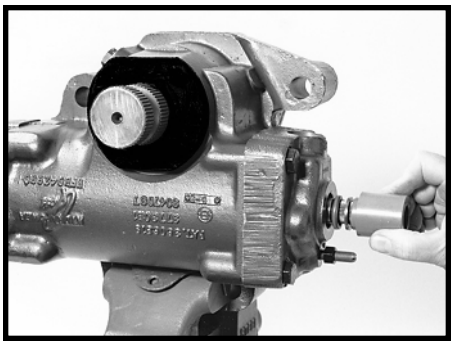

Figure 156

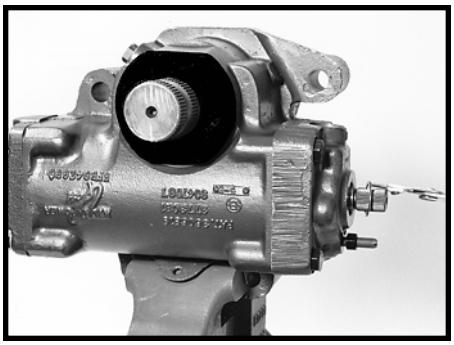

Figure 157

pack with grease, install dirt and water

49. Pack the area around the input shaft with clean high temperature industrial grease per Ross specification 045231, Mobil Temp 1 or 2 or seal equivalent, and install the new dirt and water seal (4), with part number facing out, using seal driving tool J26654 or suitable blunt-ended drift. SEE FIGURE 158. If the dirt and water seal has a rim, it should be pressed against the valve housing face. If the seal does not have a rim, the seal should be pressed in flush with the valve housing face.

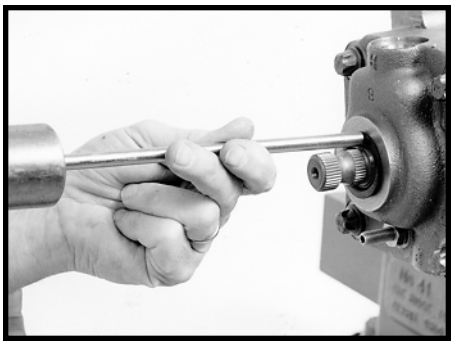

Figure 158

assemble seal protector

50. Apply more of the special grease to the cupped side of the new seal protector (62) and assemble it, cupped side in onto the worm shaft/input shaft (17) and into the serration relief groove. SEE FIGURE 159.

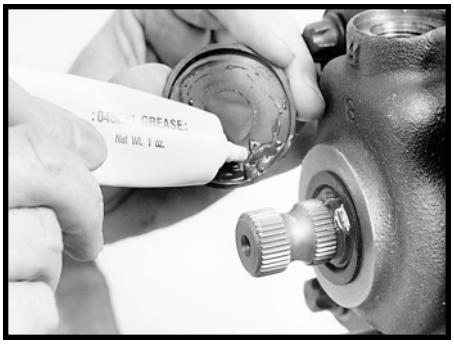

Figure 159

install manual bleed screw, if equipped

51. If your gear is equipped with the manual bleed screw (20A), install it into the gear housing (20) and torque it to 27-33 in. lbs. (3.1-3.7 N m). SEE FIGURE 160. 5/16 inch hex socket required.

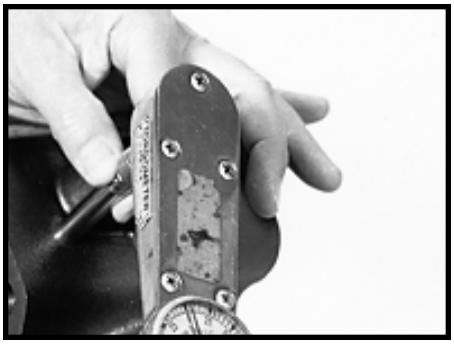

Figure 160

CAUTION

CAUTION: For next step, make sure gear is very secure in vise.

install automatic bleed screw, if equipped

52. If your gear is equipped with the automatic bleed screw (20B), position the steering gear so that the cylinder bore axis is vertical and the input shaft is pointing down. SEE FIGURE 161. Then, install the spring (20D), the special pin (20C) spherical end first, and the automatic bleed screw (20B) into the housing. SEE FIGURE 162. Torque the screw to 16-20 ft. lbs. (22-27 N m). 1/2 inch hex or E-10 Torx socket required.

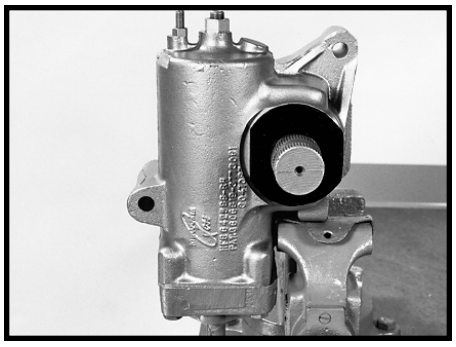

Figure 161

WARNING

WARNING: IF THE AUTOMATIC BLEED ASSEMBLY IS IMPROPERLY ASSEMBLED, THERE MAY BE A LOSS OF POWER STEERING IN ONE DIRECTION.

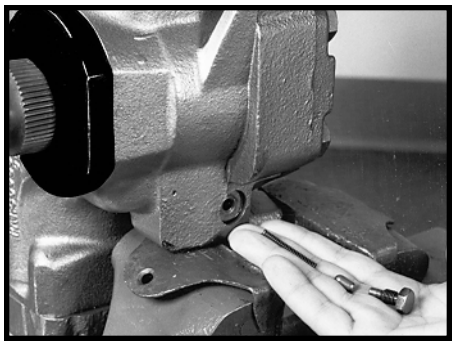

Figure 162

This completes assembly of the HFB64 steering gear. Before you install the gear into the vehicle, make final adjustments described on page 49. All ports should be plugged until unit is installed in the vehicle.

Final Adjustment

center steering gear

1. To center the steering gear, rotate worm shaft/input shaft (17) until the timing mark on the end of sector shaft (50) is perpendicular to the worm shaft/input shaft. SEE FIGURE 163. A 12 point 11/16 or 3/4 inch box end or socket required.

NOTE

NOTE: Initial worm preload adjustment was accomplished in assembly procedure 40, page 45, before assembly of sector shaft (50).

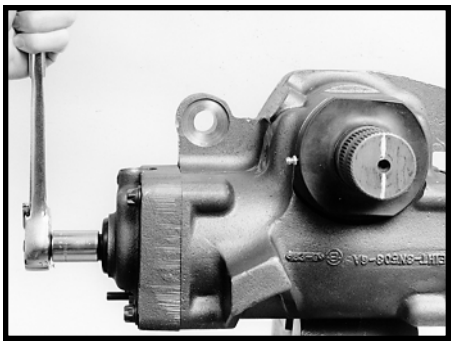

Figure 163

tighten adjusting screw

2. Tighten sector shaft adjusting screw (51) to provide 25 to 30 in. lbs. (2.8 to 3.4 N m) of torque required to rotate the worm shaft/input shaft (17) through 180¡ each side of center. SEE FIGURE 164.

NOTE

NOTE: This procedure will properly mesh and seat the rack piston teeth and sector shaft teeth for final adjustments.

loosen adjusting screw and note torque

3. Loosen sector shaft adjusting screw (51) one turn and note maximum torque required to rotate the worm shaft/input shaft (17) through 180û each side of center.

adjust adjusting screw

4. Adjust sector shaft adjusting screw (51) to increase maximum torque noted in procedure 3 by 2 to 4 in. lbs. (.23 to .45 N m). Torque jam nut (59) using a 3/4 inch socket, to 40 to 45 ft. lbs. (54 to 61 N m) and check worm shaft/input shaft torque again. Readjust if worm shaft/input shaft torque exceeds 20 in. lbs. (2.3 N m).

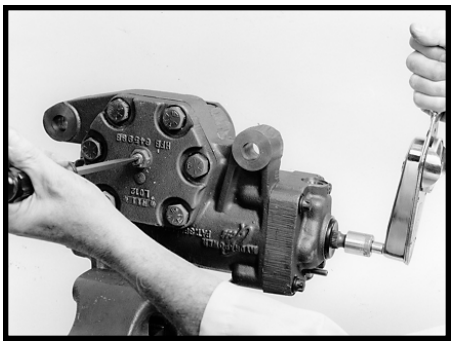

Figure 164

adjust worm shaft/input shaft adjusting screw

5. Adjust worm shaft/input shaft adjusting screw (39), a 5/16 inch Allen wrench or screwdriver required, to increase maximum worm shaft/input shaft (17) torque noted in procedure 4 by 10 to 15 in. lbs. (1.1 to 1.7 N m) Torque sealing nut (38) to 70-80 ft. lbs. (95-108 N m) using a 1-1/16 inch socket and check worm shaft/input shaft torque again. Readjust if worm shaft/input shaft torque exceeds 35 in. lbs. (4.0 N m). SEE FIGURE 165.

This completes the final adjustments of the HFB64 gear to be made before it is installed into the vehicle's steering system. Install the gear by following instructions in the vehicle shop manual. Then follow the succeeding sections of this service manual (HFB64) on "Hydraulic Fluid" and "Filling and Air Bleeding the System" which also includes instructions for adjustment of the optional adjustable poppet valves.

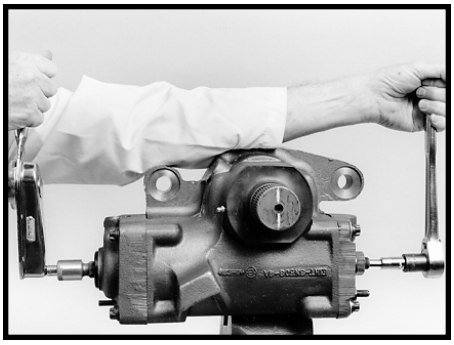

Figure 165

Hydraulic Fluid

The steering system should be kept filled with one of the following fluids:

AUTOMATIC TRANSMISSION FLUID TYPE "E" or "F"
FORD SPEC. M2C138CJ
AUTOMATIC TRANSMISSION FLUID DEXRON II
SHELL ROTELLA T . . . . . .SAE 30
MOBIL . . . . . .SAE 10W30
ASHLAND . . . . . .SAE 10W40
UNION . . . . . .SAE 10W40
TEXACO . . . . . .SAE 10W40
TEXACO . . . . . .SAE 15W40
MOBIL . . . . . .SAE 10W40
UNICAL GAURDOL . . . . . .SAE 15W40
UNICAL GAURDOL . . . . . .SAE 30
ESSOLUBE . . . . . .SAE 15W40
CHEVERON . . . . . .SAE 10W40
EMERY FRIGID-G0-OW-02 SYNTHETIC

WARNING: COMPLETELY FLUSH THE STEERING SYSTEM WITH ONE OF THE RECOMMENDED FLUIDS ABOVE ONLY. DO NOT MIX OIL TYPES. ANY MIXTURE OR ANY UNAPPROVED OIL COULD LEAD TO SEAL DETERIORATION AND LEAKS. A LEAK COULD ULTIMATELY CAUSE THE LOSS OF FLUID, WHICH COULD RESULT IN A LOSS OF POWER STEERING ASSIST.

Filling and Air Bleeding the System

CAUTION: For steps 1 and 2, do not turn the steering wheel. Otherwise, air may be induced into the system.

1. Fill the reservoir nearly full. Crank the engine for 10 seconds without, if possible, allowing it to start. If the engine does start, shut it off immediately. Check and refill the reservoir. Repeat at least three times, each time checking and refilling the reservoir.

   CAUTION: Do not allow the fluid to drop significantly or run out of the reservoir. This may induce air into the system.

2. Start the engine and let it idle for 2 minutes. Shut the engine off and check the fluid level in the reservoir.

3. Start the engine again. Steer the vehicle from full left to full right turn several times. Add fluid, as necessary, to the fill line on the dipstick.

   NOTE: Poppets, if equipped on the gear, must be adjusted so that they relieve pressure at full left and right turns to aid in the removing of air from the system. At this time, make sure any poppets are properly adjusted. If they are not, adjust them in accordance with section 4 (page 17) and repeat step 3.

The above procedures should remove all air from the steering system, unless the gear is mounted in an inverted position and is equipped with the manual bleed screw (20A). SEE FIGURE 160, page 47. If this is so, refer to step 4.

4. Remove the air from a gear mounted in an inverted position and equipped with a manual bleed screw (20A) by following steps 1, 2 and 3 above. Then, with the engine idling, steer the gear from full left turn to full right turn several times. With the steering gear in neutral (no steering action), loosen the manual bleed screw about one turn, allowing air and aerated fluid to "bleed out" around the bleed screw until only clear (non aerated) fluid is bleeding out then close the bleed screw. 5/16 inch socket required. Check and refill reservoir.

   Repeat this procedure 3 or 4 times starting with the steering maneuver with bleed screw closed, until only clear (non aerated) fluid is discharged when bleed screw is loosened. Torque the manual bleed screw to 27-33 in. lbs. (3.1-3.7 N m). Check and refill reservoir.

   CAUTION: Do not turn steering wheel with bleed screw loosened as this could induce air into the system.

   WARNING: DO NOT LOOSEN OR REMOVE THE AUTOMATIC BLEED SCREW (20B) (SEE FIGURE 162) WHEN THE STEERING GEAR IS MOUNTED ON THE VEHICLE. IF IT IS LOOSENED OR REMOVED, THERE MAY BE A LOSS OF POWER STEERING ASSIST IN ONE DIRECTION OF TURN. THE AUTOMATIC BLEED SCREW CAN BE IDENTIFIED BY ITS 1/2" HEX HEAD OR E-10 TORX HEAD. IF AUTOMATIC BLEED SCREW COMPONENTS ARE INADVERTENTLY REMOVED, INSTALL THE SPRING, THEN THE SPECIAL PIN, SPHERICAL END FIRST INTO HOUSING. ASSEMBLE AND TORQUE BLEED SCREW TO 16-20 FT. LBS. (22-27 N M).

Warnings for Proper Steering Gear Operation

WARNING: DO NOT WELD, BRAZE, OR SOLDER ANY STEERING GEAR OR SYSTEM ARM COMPONENTS.

WARNING: MAXIMUM FLOW UNDER ANY CONDITIONS MUST NOT EXCEED 6 GPM (22.7 LITERS/MIN).

WARNING: MAXIMUM OPERATING PRESSURE MUST NOT EXCEED 2000 PSI (137.9 BAR).

WARNING: ALWAYS CAREFULLY INSPECT ANY STEERING COMPONENT WHICH HAS BEEN (OR IS SUSPECTED TO HAVE BEEN) SUBJECTED TO IMPACT. REPLACE ANY DAMAGED OR QUESTIONABLE COMPONENT.

Steering System Maintenance Tips

- Prevent internal bottoming of the steering gear. Carefully check axle stops to be sure that they meet the manufacturer's specifications.

- Regularly check the fluid and the fluid level in the power steering reservoir.

- Keep tires inflated to correct pressure.

- Always use a puller, never a hammer or torch, to remove pitman arms.

- Investigate and immediately correct the cause of any play, rattle, or shimmy in any part of the steering linkage or steering mechanism.

- Remove the cause of steering column misalignment.

- Encourage all drivers to report any malfunctions or accidents that could have damaged steering components.

- Do not attempt to weld any broken steering component. Replace the component with original equipment only.

- Do not cold straighten, hot straighten, or bend any steering system component.

- Always clean off around the reservoir filler cap before you remove it. Prevent dirt or other foreign matter from entering the hydraulic systems.

- Investigate and correct any external leaks, no matter how minor.

- Replace filters and pumps in compliance with specification.

- If extended stationary use of vehicle is developing excessive hydraulic fluid temperatures consult vehicle manufacturer for auxiliary cooling method.

- Maintain grease pack applied behind the input and output shaft's dirt and water seal and seal protector as a general maintenance procedure. Grease fitting provided in output shaft seal protector.

TRW Automotive
Commercial Steering Systems
800 Heath Street
Lafayette, IN 47904
Tel 765.423.5377
Fax 765.429.1868
http://www.trw.com/commercialsteering

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